Editorial

THE Royal Commission on television has caused many of us to apply our minds to some special problems associated with television services when they become available. So far, little technical evidence has been given, but there are one or two important points about which there should be plenty of constructive thinking.

One of these concerns station coverage. Operating on the VHF bands, the useful television programme area will be limited primarily by the height above the ground of the radiating aerial. For instance, an aerial on the present site of the Gore Hill FM station in Sydney might be expected to produce a good signal over the metropolitan area, including the outer suburbs. Pictures beyond about 35 miles away may be something of a gamble unless the receiving aerial is high and of special design.

But a transmitting aerial located at a high spot in the nearer Blue Mountains area might command a much greater coverage than this. It would be more costly, and might prejudice reception in some of the deep gullies in Sydney. But, remembering that we will probably have only a few stations for some time, these should be sited to serve as many set buyers as possible.

Lessons could be learned, for instance, from the results of the super power station at Sutton Coldfield, in England, which is reported to be serving reasonably well over distances of 100 miles. It might not be practicable to use as much power in Australia, but ten or fifteen kilowatts should not be too much to hope for. Such a station would send out a mighty signal over quite a distance.

A second point concerns electrical interference with programmes. Australia has done very little to legislate against interference, and will certainly find the need to press for suppression of motor car ignition interference, power line radiation and commercial electrical apparatus. Again we have examples from overseas, where inbuilt ignition suppressors are becoming compulsory, and power lines are run underground. It will be too late to worry over these problems when they are with us. They are part and parcel of the complete television picture.

Finally, we have not yet done much in Australia to educate our servicemen in keeping television sets operating. This is likely to be a major headache for some time, probably necessitating the set manufacturers making service facilities available to purchasers.

Sooner or later, however, service work must graduate into the hands of service technicians, and they will have much to learn. The major factories might well co-operate with appropriate professional institutes so that familiarisation courses can be held for servicemen.

This is a subject which is vital if Australian television is to prosper.

John Moyle

RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Working in the grounds of the AWA Ashfield Factory, two engineers are shown testing the aerial system for a 35-channel microwave link operating between Canberra and Sydney and supplementing the normal telephone trunk system. The new link will be one of the most advanced of its type in the Commonwealth.

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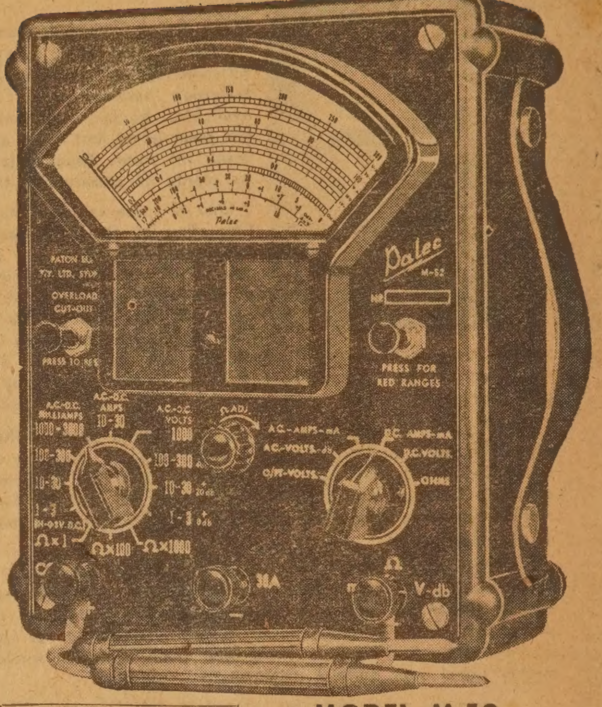

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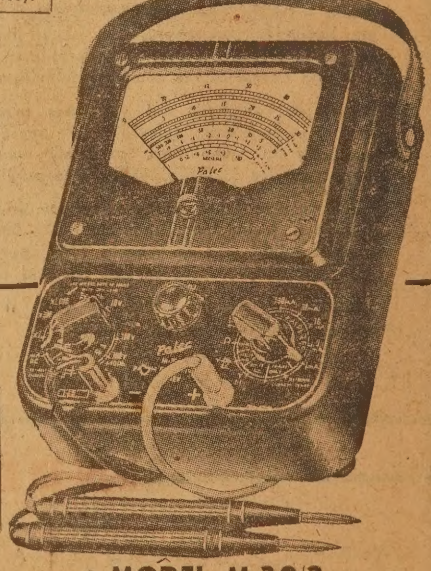
Current A.C. 0/1 mA. (for use with ext. current transformers)	1
Ohms 0/1000: 0/10000: 0/1 megohms	3
Decibels Ref. level 1 mW. in 600 ohms	3
" Ref. level 6 mW. in 600 ohms	3
Total	30



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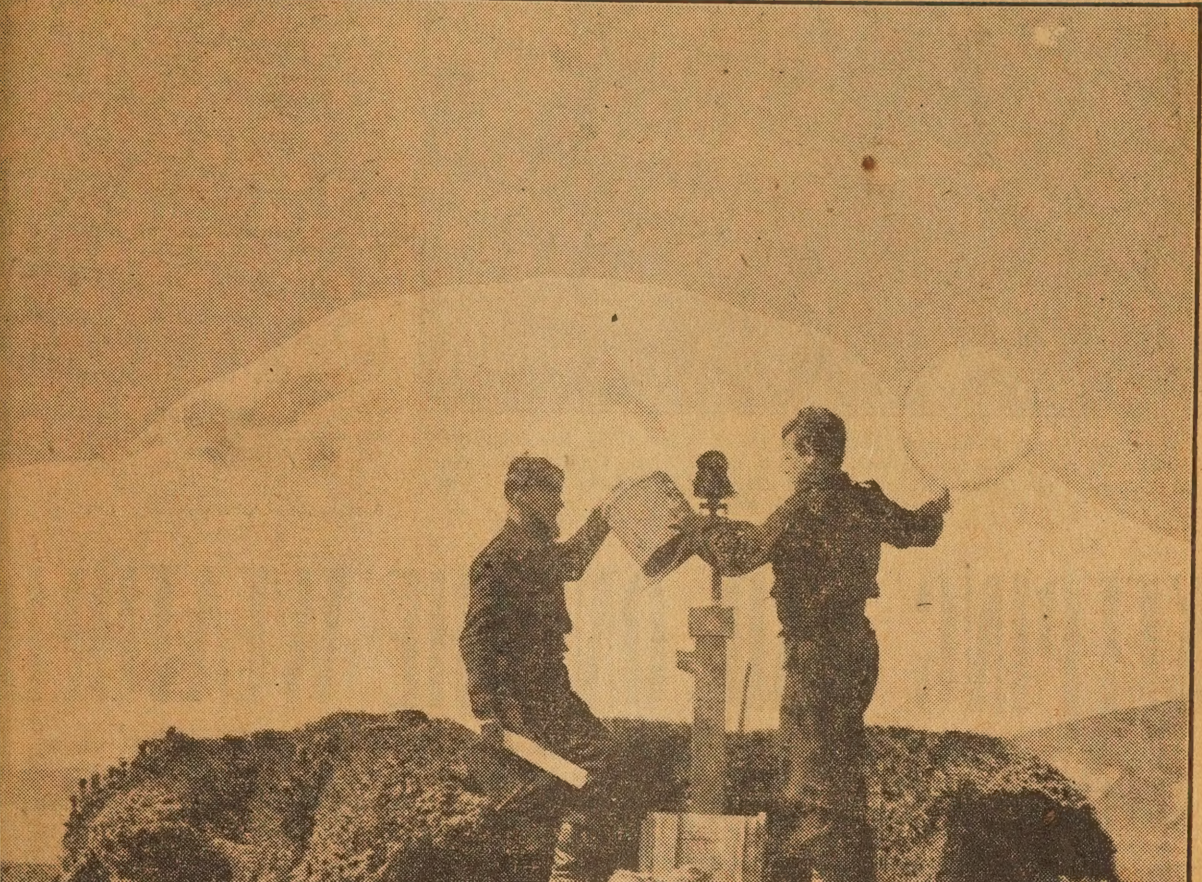
WEATHER-MEN IN THE ANTARCTIC



RELEASING a small meteorological balloon at Heard Island to measure wind velocities. The snow-covered mountain in the background is "Big Ben," 9005 feet high. See story next page.

A.N.A.R.E. photo.

Preparing to launch a radiosonde balloon at Heard Island. The tiny transmitter attached to the balloon automatically transmits signals which can be interpreted as readings of temperature, air pressure, &c. (Pictures by courtesy Antarctic Div., Dept. of External Affairs).

KEEPING TAB ON THE WEATHER

While most of southern Australia sweltered in heat waves this summer a handful of young, keen scientists on a chain of Antarctic outposts rugged themselves up, sipped their hot beef tea and sent messages to Australia telling us when cooler weather could be expected.

by Roth Jones

THESE men were the almost forgotten Australian, New Zealand, South African and French meteorologists who have chosen 12 months' isolation, raging gales and extreme cold in preference to the comfort and warmth of a modern civilisation.

Their story and help to Australian meteorology is one of the untold tales of the icy south. Few people who talk about the weather, read about it in the papers or hear the radio forecasts, realise the importance of these outposts to Australian meteorology or the need for extending their work to the Antarctic continent.

VITAL INFORMATION

To thousands of newspaper readers and radio listeners, weather forecasts mean little more than what to expect tomorrow or what clothes to wear; but to the farmer and many industrialists they represent advice on which many thousands of pounds are gambled and rarely lost.

The wheat farmer will begin harvesting late in the summer if assured of fine weather or work around the clock if told of coming storms; the grazier will watch his sheep and lambs closely if a cold snap is forecast, and the civil engineer will stop laying concrete if warned of wet weather. The airman, too, has learned to depend on weather almost as much as the engines which drone incessantly each side of him.

Since the establishment of the Commonwealth Meteorological Service early this century, forecasters have constantly sought to extend the period and increase the accuracy of their predictions. More and more stations were set up on the Australian mainland and near neighboring islands to help attain this goal.

But the weather of southern Australia comes from the west and the south and the lack of observations from the Southern Ocean prevented meteorologists from predicting those violent storms which occasionally sweep up unannounced from the roaring forties.

Most of southern Australia's weather travels from west to east, originating in outbursts of cold air from Antarctica. Once a depression has hit the continent its characteristics can be determined quickly and plotted on the map.

SIX OUTPOSTS

Since the establishment of bases on six Antarctic Islands bordering the 50th (southern) parallel in the last four to five years, forecasting has become more reliable. As yet it is not equal to the northern hemisphere for accuracy, due to the large number of stations based on land above the 50th (northern) parallel.

Few have contributed more to Australian meteorology in recent years than these bearded scientists of the Antarctic. Hundreds of Australian radio amateurs have met them "over-the-air" and learnt first hand the intricacies of the Antarctic weather. Every few hours they send reports to Australia in a bid to help solve our No. 1 weather

Looking down on the ANARE station at Macquarie Island. This island lies 900 miles south-east of Hobart.

oblem: "What is happening in the
as south and to the south-west of
ıstralia."
The string of islands stretches
om South Africa's Marion Island,
0 miles south-east of Durban, to
w Zealand's Campbell Island, 450
les south of Invercargill. Aus-
lia has two bases, at Heard Island,
00 miles south-west of Perth, and
acquarie Island, 900 miles south-
st of Hobart, while the French op-
ate from Kerguelen Island, 280
les north-west of Heard and Am-
rdam Island, 1000 miles farther
the north-east.
Each island is staffed by skilled
teorologists, most of them gradu-
es from British, Australian, South
rican, New Zealand and French
iversities. Many have written
pers on their findings in the icy
ith which have been published in
rld scientific journals. High
wered radio stations with their
tennae beamed on Sydney ensure
speedy despatch of the coded
ather information to Australia.

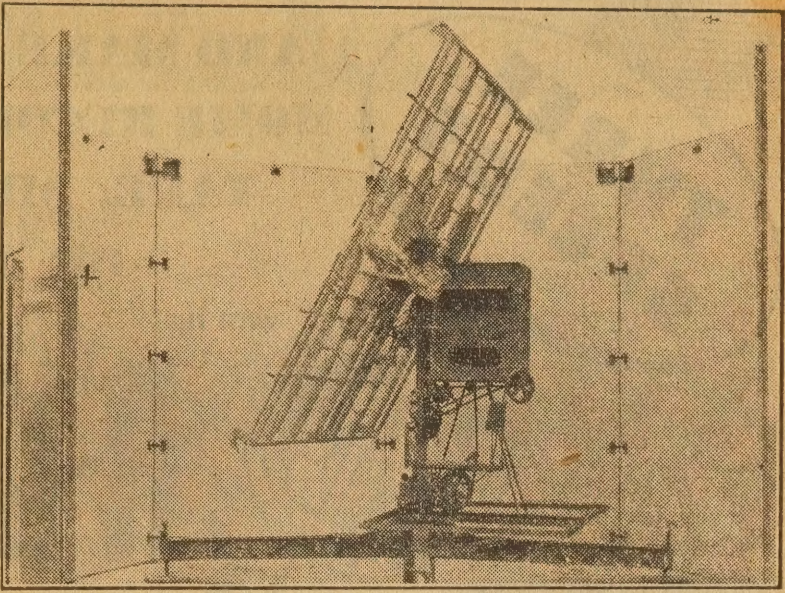
ODERN EQUIPMENT

Despite the primitive nature of
eir camps, these men use some of
world's most modern meteori-
ical equipment, including the
liosonde, a small "flea-power"
lio transmitter attached to a bal-
n which relays to earth the vari-
s pressures and temperatures in
upper atmosphere as it floats
ward.
Frequently balloon flights are
de in biting snow blizzards with
ibility zero. Within a few hours
the readings from the radiosonde
d other delicate equipment being
en, they have been coded and
nsmitted to Australia, decoded
d plotted on the charts at the
stralian meteorological bureaus.
Even the British, Scandinavian and
panese whalers who seek their prey
the ice cluttered waters bordering
Antarctic continent during the
mmer months send in regular re-
ts during their brief stay.
When these ships have been op-
ting in the vast, uninhabited area
ween Heard and Macquarie
nds, this information has been
st useful, as no permanent weather
ion is operating there at present.
Strangely enough, these whalers
a highly secret code, reminiscent
he wartime navy ciphers, to hide
ir position from other whalers
o could share in the spoils. The
e is known only to the Australian,
v Zealand and African meteoro-
cal services, which are honor
nd not to divulge the positions.

INHABITED AREA

he vast, uninhabited areas be-
en Heard and Macquarie Islands
he weak link in Australia's An-
tic meteorological chain. The
lers go south only in the sum-
, and their reports are incom-
e because their equipment is
ted. For the most part of the
, forecasters must rely largely
guesswork in this vast area so
l to Australian weather.
hen the French operated a base
Adelie Land, their tiny sector of
vast Antarctic continent, they
plied Australia with four-hourly
ther bulletins. Unfortunately,
ster struck this important link
y one morning as the Aurora
ralis lit up the sky and the
p, including the meteorological
pment, was burnt. The French-
had to sail for home, many
tears in their eyes.

DESTINED FOR HEARD ISLAND



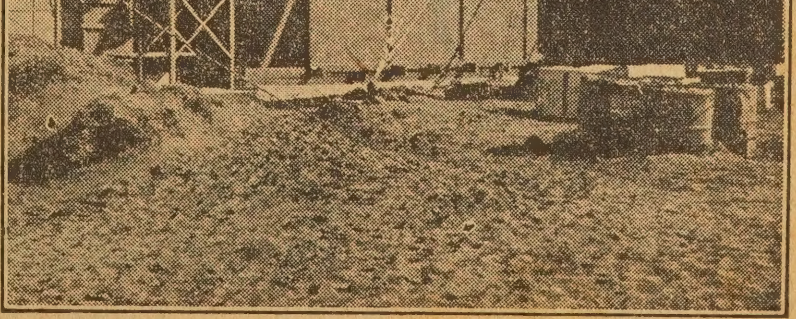
This "radio-theodolite," capable of tracking radiosonde balloons, is to be installed shortly at Heard Island. It is housed in a specially designed hut which will give protection against the weather without interfering with proper functioning of the aerial system.

Until a base is established on Australia's vast uninhabited sector of Antarctica, the Australian weather map must remain incomplete and slightly inaccurate.

Australia's sector extends eastward from a point south of Madagascar to another south of Macquarie Island and inland to the South Pole, with the exception of Adelie Land mentioned earlier.

Six years' expedition work at Heard and Macquarie Island has stimulated a group of enthusiastic highly trained men, who are longing for the chance to go further south. The expedition headquarters in Melbourne has an efficient and experienced administrative organisation, which can maintain the men in the field and the meteorological service is eager to provide all the equipment needed to tackle the multiplicity of problems which confront the weather man in the roaring gales and blinding snow storms of Antarctica.

A weather station in the Australian sector would repay the cost of its establishment with information vital to accurate forecasting. Scientific knowledge from such a base would also be worthwhile.



Buildings at the island outposts have to be easily assembled, yet capable of protecting personnel against extreme weather conditions. This group of huts at Heard Island are (left to right) radio hut, meteorological hut and the anemometer hut.

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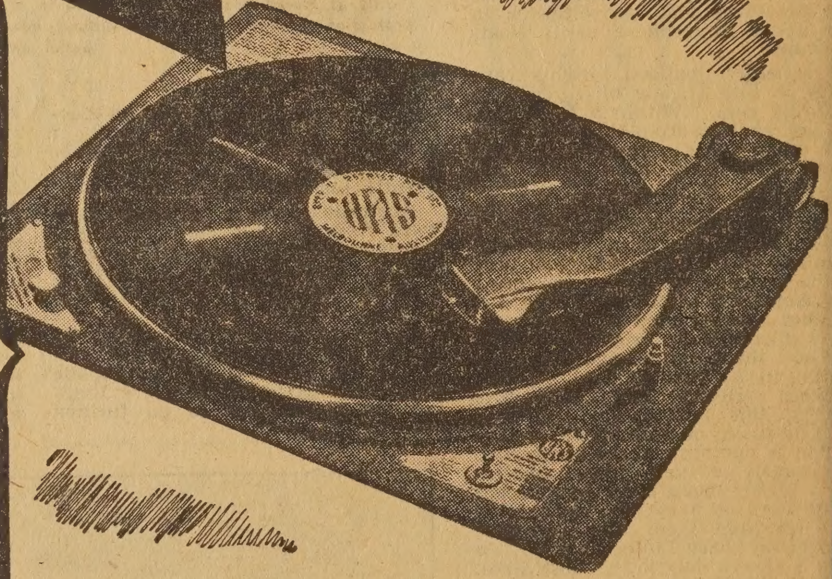

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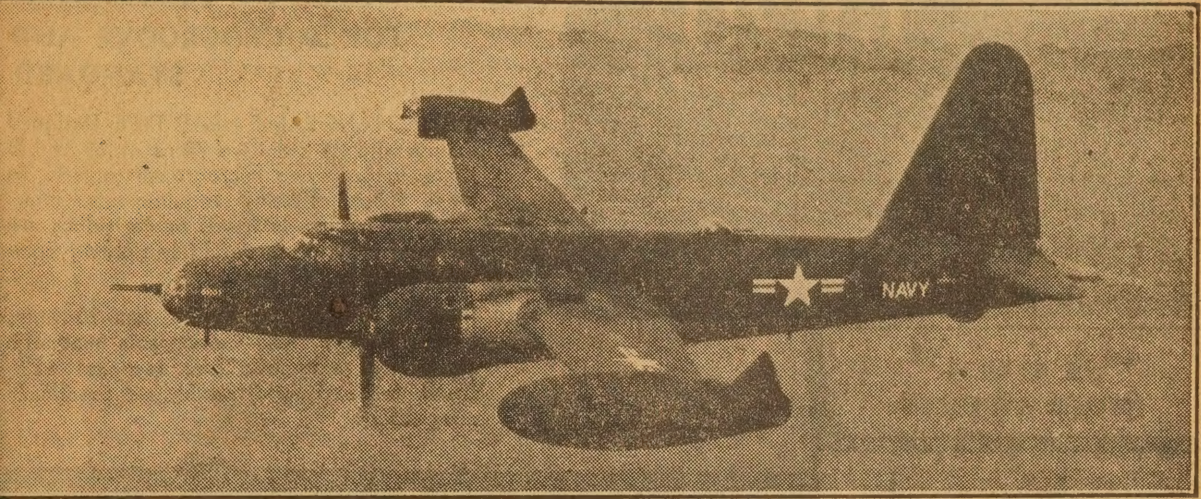
"HOTTED-UP" NEPTUNE FOR U.S. NAVY



Specially designed for anti-submarine warfare and mine-laying, the versatile US Navy P2V-6 Neptune is pictured above making its first flight from the Lockheed Aircraft Corporation.

Another weapon for America's air arsenal was disclosed recently when Lockheed Aircraft Corporation announced that the P2V-6 Neptune, a US Navy plane specially designed for mine-laying and anti-submarine warfare, was now undergoing flight tests.

HE ocean-spanning plane is powered by turbo-compound en- nes, capable of providing all the tra range, high speed and power- -a-pinch needed for its advanced nd base operations, Lockheed re- rted.

The big, twin-engined ship made first flight October 14.

Markedly changed from the P2V-5, anti-submarine plane which con- nues in quantity production at ckheed, the P2V-6 is convertible r highly specialised missions, in- uding new mine-laying assign- ents.

Although details on its extensive ectronics and convertibility features ere withheld, navy officials con- med that the P2V-6 can serve also r night torpedo attacks, mast-level mbing, horizontal bombing and oto reconnaissance.

HIRD MODEL

The P2V-6 is the third member of e Neptune family to be powered Wright turbo-compound engines, ich use exhaust-driven turbines augment regular piston power. roduced by Lockheed two years o on the P2V-4, turbo-compounds e now flying on Super Constellation nsports for the navy and soon ll enter first airline use on Super nstellations, fastest US passenger ne.

Highlights of P2V-6 design are its usually long range for sea patrol, borate scientific instruments to k up and pinpoint targets, and ensive armament (types and antities secret).

Despite its heavy fighting weight, plane can operate from limited ward airfields and even carriers, with eight 1000lb-thrust JATO (jet-assisted take-off) units.

Appearance of the P2V-6 will vary with different types of missions. Interchangeability for mine-laying or anti-sub work permits a wide selection of armament, Lockheed reported.

The plane resembles other aircraft of the Neptune family, but has a longer nose, smaller wingtip tanks and smaller radar dome. More than 1ft has been added to the nose, providing added room for the forward crew and improving access to equipment. Change in placement and design of equipment dictated the smaller tanks and radome, engineers said.

A new feature with the P2V-6 is pressure-fuelling, for fast-feeding fuel into wing tanks to save time under combat conditions. A companion feature provides rapid emptying of tanks for safe storage or repair in hazardous situations.

Also new on the P2V-6 are stainless steel engine nacelles, highly fire resistant.

VERSATILE

Neptune design provides for maximum tactical utility with its long range for patrolling over vast distances, high speed for rapid closing on targets and defensive manoeuvring, ability to take off and land on small fields, and maximum single-engine performance.

Service and maintenance features engineered into the Neptune design are responsible for the aircraft's high availability record with operating squadrons, Lockheed engineers reported. For example, a complete wing has been removed and replaced by a half-dozen men working an hour and a half; and three men changed a nose landing gear in 36 minutes.

Neptune engineering is directed also toward production efficiency, permitting 51 pc of manufacturing on the P2V-5 and -6 to be subcontracted to other companies for quantity output.

Neptune development dates from its original conception in 1942. The design is distingushed by its tricycle landing gear, with steerable nosewheel, and varicam tail — a variable camber feature of the horizontal stabiliser which contributes to ease of operation.

RECORD FLIGHT

An early model established a long-range record, still standing, for non-stop flight without refuelling from Perth, Australia to Columbus, Ohio — a distance of 11,236 miles.

Neptunes were the first production aircraft to take advantage of the extra power of compound engines, introduced on the P2V-4 design. The current model is powered by two Wright 3250-hp units, equipped with water injection for maximum power on take-off or in combat.

Propellers are a four-bladed Hamilton Standard type, with full feathering and reversible pitch.

The P2V series has seen service with the US Navy in the United States as well as at bases in Alaska, Newfoundland, Canal Zone, Hawaii, Okinawa and Japan. With the P2V-5, the series was introduced to the military air services of England and Australia through provisions of the Mutual Defence Assistance Program.

BEFORE testing a newly-completed set, inspect it for small blobs of solder or wisps of wire shorting pins or other connections of the chassis. It may prevent the sudden demise of a rectifier or other component.

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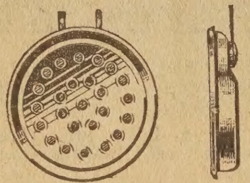
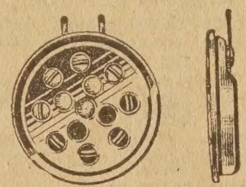
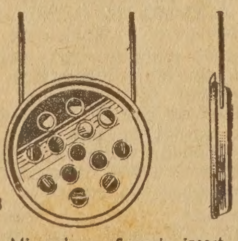

MIC 3

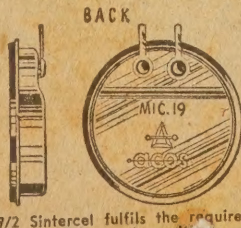
MIC 3 Diaphragm-actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity. Price, 39/3.


MIC 14

MIC 14 Standard Speech Microphone itself with nickel plate brass case which gives high corrosion resistance, mechanical strength and rigidity. PRICE, 39/3.


MIC 18

MIC 18 Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required this insert is recommended. PRICE, 39/6.



MIC 19/2 Sintercel fulfils the requirements for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction. PRICE, £2/19/9.

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The Acos GP30 turnover head type pick-up is fitted with two separate sapphire styli, one for standard and one for microgroove records, either of which can be placed into operating position by a simple turn of a knob at the front end of the pick-up arm. The knob is clearly marked to show which stylus is ready for use.

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Cartridges (for GP.20 microgroove) GP.19L.P.	£2/19/9.
Cartridges (for GP.30 turnover) GP.29.	£2/19/9.
Cartridges (for GP.10 standard) GP.9.	£1/11/6.

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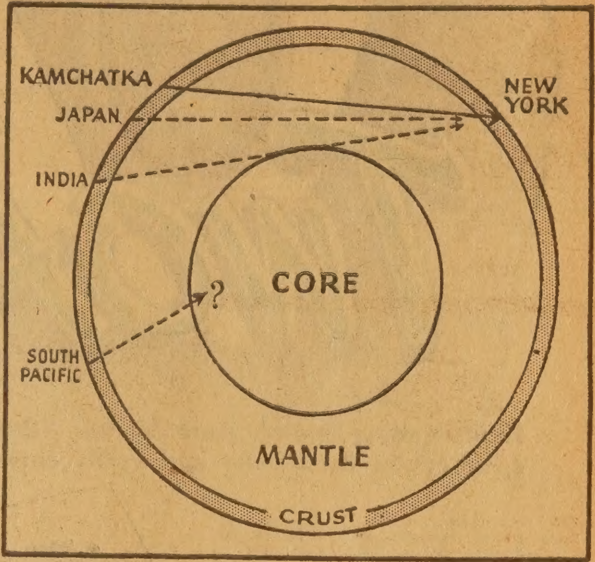
EARTH'S CORE STILL A MYSTERY

Looking upward, man has penetrated space to points a billion light years distant and has found countless galactic universes like our own. But looking downward, he has struggled in vain to find what is 4000 miles beneath our feet. The centre of the earth remains an unpenetrated mystery.

N the rocky caverns at Palisades, NY, that house the Lamont Geo- gical Laboratories of Columbia niversity Professors W. Maurice wing, director, and Frank Press, ismologist, are making efforts to se very long earthquake waves to xplore that silent area.

For small distances shocks are roduced by dynamite explosions, ut for greater depths scientists must epend on the more powerful waves roduced by earthquakes. At great epths, changes take place in these aves. The changes reveal the in- rnal conditions along the paths the aves traverse.

There is a central region that no ave has been able to penetrate, at least come out in any form which seismologists can recognise em. The route directly through e centre of the earth is blocked by mysterious core.



Top lines show the probable course of earthquake shock waves as recorded at Lamont Laboratory. They narrowly missed the earth's core. But the waves of a South Pacific quake would either penetrate the core or bend around it. Scientists hope to find out which.

HAT'S UNDERNEATH

Seismologists calculate the earth is an outer crust twenty-five miles ick, a rocky mantle 2000 miles eep and an inner core that ex- nds the remaining 2000 miles to e centre.

Earthquake waves travel easily rough the curved surface crust and e readily transmitted through the antle, which enables them to take ep, straight-line shortcuts through e earth and arrive at a given int before the surface waves tak- g the longer route. The differ- ce in arrival times of the two ts of waves enables seismologists to l the distance from their station which an earthquake took place.

There is a limit to these short- ts. When the straight-line goes ep enough to touch the core of e earth the wave on this route dis- pears. What happens to it?

The standard explanation is that e mantle of the earth is hard, sslike and a good wave conduc- , but that the core is liquid, hot d viscid, and cannot transmit rthquake waves, which are visu- sed as having a sidewise wiggle. e core is supposed to be com- sed of iron made molten by heat m a tremendous gravitational essure from the overlying mantle.

UCH SPECULATION

Whether this explanation is true not is a matter of great uncer- nty. The iron core theory is de necessary because the rocks t compose the outer layers of earth have a mass of 166 nds a cubic foot. The greater sity of the earth as a whole ld be explained by the 4000- e diameter core being composed iron, which has a mass of 450 nds a cubic foot.

his iron core would be a great rtial mass that would slightly retard the earth in its response to certain gravitational perturbations, enough for astronomers to measure as star shifts. They have been unable to find these shifts, so some doubt arises as to whether the iron core has a real existence.

When deep holes are drilled in the earth, rock temperatures are observed to rise at the rate of 30 degrees a mile. If this rise is continuous, the temperature at the centre of the earth would be 12,000 degrees, much more than enough to melt iron.

By John J. O'Neill

(from New York)

No hole, however, has been drilled deeper than a few miles, so extensions beyond that depth are pure conjecture. All such holes have been drilled in continental masses. No holes have been drilled in the ocean bottom.

There the temperature is uniformly one degree above the freezing point. If the earth below the oceans were as hot as it is in continental rocks, the oceans should have higher temperatures. The hot core theory is thus in need of factual support.

The theory of tremendous gravitational pressures (considered a source of heat) can stand re-examination. An object in the centre of the earth has no weight (gravitational pressure). It is pulled equally in all directions.

A body 100 miles from the centre experiences only the gravitational pull of matter within the central 100-mile radius sphere. The forces from all matter outside this sphere neutralise each other. This is true of all other sub-surface points.

This current core theory, despite its weaknesses, serves a useful purpose in that it is consistent with the observed fact that earthquake waves cannot get through it. It is like a ghost that casts a shadow. It is the best picture we have at the present time, and scientists will continue to use it until they can acquire facts on which to build a better one.

NEW EQUIPMENT

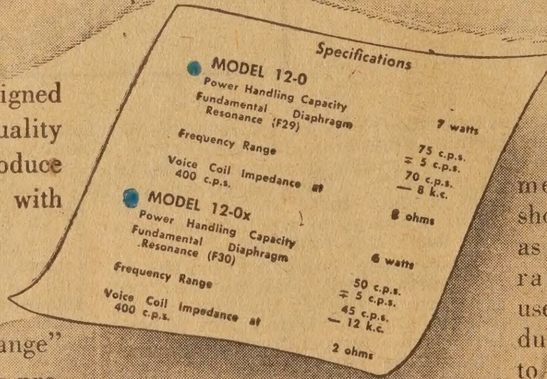
These much desired facts may come out of the special very-long-wave-length seismograph which Professors Ewing and Press have built and installed at the Lamont laboratories.

Earthquake waves, like radio waves, come in various lengths, and seismographs that record them must, like radio receivers, be dynamically tuned to particular wave lengths or frequencies.

A tremendous earthquake occurred in the almost uninhabited peninsula of Kamchatka, Siberia, on November 4. The new seismograph was beautifully tuned to the resulting waves, which were found to have a

(Continued on page 89)

Experts have hailed Rola Models 12-0 and 12-0x as the world's finest loudspeakers in their class and vastly superior to many more expensive types.



Specifications

● MODEL 12-0

Power Handling Capacity	7 watts
Fundamental Diaphragm Resonance (F29)	75 c.p.s. ∓ 5 c.p.s.
Frequency Range	70 c.p.s. — 8 k.c.
Voice Coil Impedance at 400 c.p.s.	8 ohms

● MODEL 12-0x

Power Handling Capacity	6 watts
Fundamental Diaphragm Resonance (F30)	50 c.p.s. ∓ 5 c.p.s.
Frequency Range	45 c.p.s. — 12 k.c.
Voice Coil Impedance at 400 c.p.s.	2 ohms

Model 12-0 was designed for use in high quality radiograms to reproduce 78 r.p.m. records with fidelity and realism. The later Model 12-0x catered for "wide range" enthusiasts who were prepared to use the most expensive types of pick-ups and amplifiers.

Model 12-0x is too fine a loudspeaker to use with ordinary equipment, but the advent of L.P. discs made desirable a loudspeaker possessing a top response between that of 12-0 and 12-0x. Rola met this with a 12-0 fitted with a special F29 diaphragm giving a very even response to 8 k.c. This new 12-0 is the practical answer to the problem of getting maximum performance from standard equipment although it should be stressed that, as with any extended range loudspeaker used for record reproduction, it is essential to use a pick-up the response of which is free from peaks and undesirable resonances. The improved Model 12-0 can be identified by its diaphragm which has five concentrically spaced corrugations and a glossy finish to its rim.

Model 12-0x is *still* Australia's finest extended range loudspeaker, but the new 12-0, with its F29 diaphragm, does an equally fine job in the field for which it was designed.

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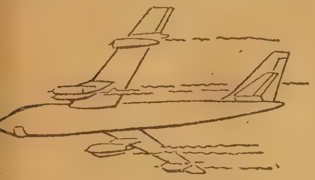
THE SHAPE OF WINGS TO COME

Fierce partisanship by the designers of new jet bombers makes it confusing for the layman to decide between the rival claimants for the virtues of radically different wing shapes. This article will give you some idea of what it's all about. It will indicate, too, that there is as yet no undisputed answer to the problem of wings for near-sonic speeds.

By special arrangement with "Financial Times," London.

HE introduction of the jet engine 'made possible the use of powers herto undreamed of for large oplanes and, consequently, speeds nmensurate with those of jet fight-. But the problems associated h designing bombers for jet power far more complex and revolu- ary than those encountered with fighters.



Swept, narrow wing (Boeing B-47)

'irst and foremost, the jet engine's h fuel consumption is a far great- handicap to a bomber than to ighter. To mitigate this factor jet bomber must fly very high t least 50,000 feet, where the er density of the air drastically uces fuel consumption—and must nb to its operating height as t as possible.

'light in the stratosphere, how- r, brings its own problems. Large ig area is necessary to provide where the air density is less n a fifth of its sea level value. sides this, air pressure is less n a sixth of that at sea level, ile temperature is minus 56 deg itigrade, so that weighty pressure ins and heating are required for crew and certain equipment. At t height, moreover, the speed of nd is only 660 mph compared h 762 mph at sea level which ans that an aeroplane cruis- at 600 mph is travelling at a ch Number of 0.9 (Mach 1.0 being speed of sound).

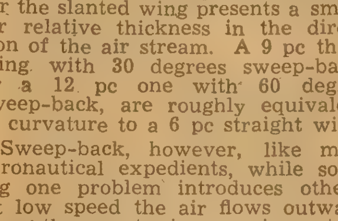
RROW WINGS

'rom the purely aerodynamic wpoint, that is, the shape of the craft, a long, narrow wing gives best lift for the lowest drag, , therefore, the smallest expen- ure of power and fuel. However, he aircraft is to fly at Mach 0.9 wing must not be thicker than c of its width, or again the drag l rise—and very sharply indeed. s particular form of drag is caus- by the formation of shock waves, ere the speed of the air passing e part of the aeroplane has reach- the speed of sound. It is the for- tion of these shock waves, first the most curved parts and later m the whole aircraft, that con- ute the "sonic barrier."

'o make a narrow wing as thin possible, so that it will not set up shock waves, is a considerable structural problem. Some gain can be obtained from sweep-back, which is a way of cheating geometrically, for the slanted wing presents a smaller relative thickness in the direction of the air stream. A 9 pc thick wing with 30 degrees sweep-back, or a 12 pc one with 60 degree sweep-back, are roughly equivalent in curvature to a 6 pc straight wing.

Sweep-back, however, like most aeronautical expedients, while solving one problem introduces others. At low speed the air flows outward along the swept wing, causing a tendency for the tips to stall and drop, while aileron control is poor. At high speed, the aileron may twist the wing instead of rolling the aircraft, so reversing the action of the controls.

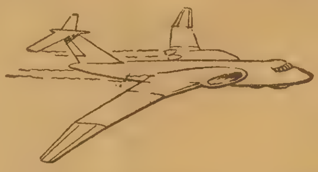
Designers have approached these problems in several ways. The Americans have chosen the thin, flexible, narrow wing, but have to face considerable structural and installation problems. In the Boeing jet bombers, strength is maintained by making an elastic structure which yields under load but returns to its normal shape—the wingtips of the B-47 can deflect 15 feet without harm. Such a wing, however, is too thin to contain engines, undercarriage and fuel tanks, so that the extra drag of external engines and fuel tanks must be accepted, while the fuselage itself has to be made large enough to carry fuel and undercarriage.



Compound swept wing
(Vickers Valiant)

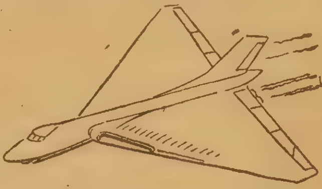
The new British bombers were built to an Air Ministry-Ministry of Supply specification which called for certain load, range, speed, and ceiling figures. The tendering companies were left free to fulfil the requirements as each thought best. This has resulted in three radically new approaches to the problem—an unusual swept wing, a delta, and a "crescent" wing.

Resistance to the temptation to pile more and more weight on each square foot of wing has been a characteristic of British post-war designs. And one official requirement in particular which led to these new approaches was insistence upon a moderate wing loading (that is, a fairly large area of wing compared with the weight of the aircraft), which is approximately half the American figure. The smaller the area of the wing compared with the aircraft's weight, the more power is required to get the aircraft off the ground, and to keep it up in the stratosphere.



Crescent wing (Illustrative of H.P. 80)

A moderate wing loading, with a large wing area, indicates a reasonably thick wing root, and therefore makes it possible to bury the engines close to the body. However, in the size of bomber required, the wing roots would have been scarcely thick enough to take engines, air ducts and structure as well, if the wings were simply swept straight back. In the Vickers Valiant, which is virtually a compound taper wing, the wing roots are swept forward, so permitting an increase in thickness at the root, in which the engines are almost completely buried. The twisting problems are overcome by an ingenious structural "hinge" which prevents the wing from deflecting out of line.

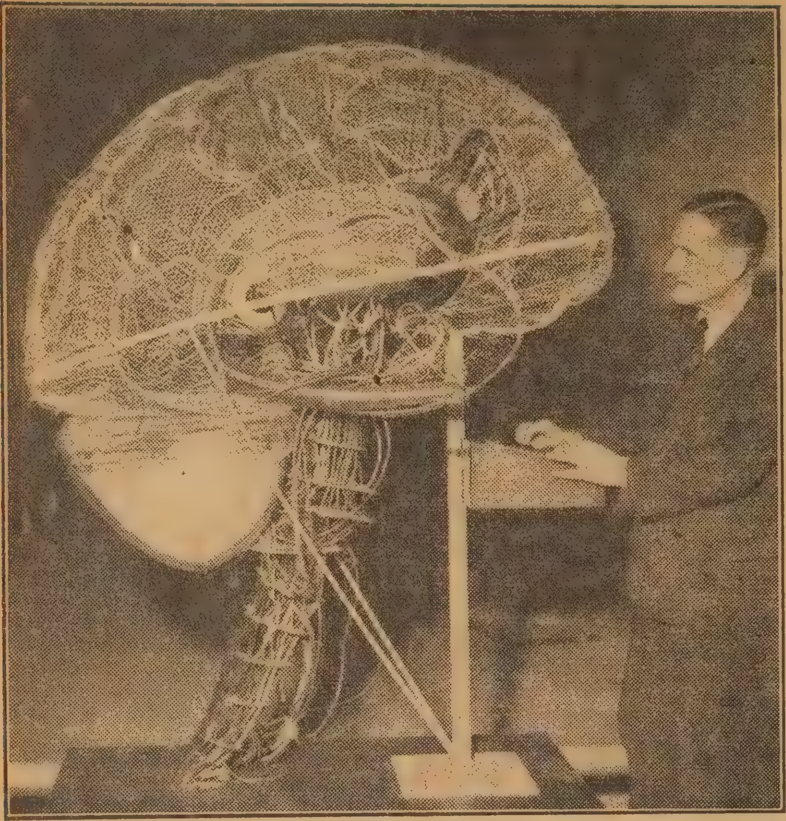


Delta wing (Avro Vulcan)

The crescent wing of the Handley Page HP80 is an application of graded taper and thickness. Ideally it should be a true crescent, but this would be prohibitively expensive in manufacuring time. Instead, three different degrees of thickness and sweep-back are used, thus combining to some extent the advantages of the swept wing at high speed with the good handling characteristics of the unswept wing at low speed.

The thin, straight tip of a crescent wing gives better aileron control than a swept one, and it can

(Continued on Page 19)



This huge plastic model of the human brain has just been installed in Vienna's technical museum. Appropriate sections of the brain are illuminated when the model is made to simulate thinking, hearing, seeing, or tasting. Dr. Joseph Nagler, director of the museum is shown operating the model.

“TUNING IN” ON BRAIN WAVES

The processes which enable the brain and nervous system to control the functions of the animal body have given rise to a new science called the science of Cybernetics.

THE word cybernetics was coined by an American mathematician named Norbert Wiener, who wrote a book on the subject and defined the meaning of the word as “control and communication in the animal and the machine.”

Fundamentally, cybernetics is bound up with the study of the brain and nervous system of animal and human bodies, with particular reference to the electrical phenomena which take place within the bodies.

The discovery that there are such things as brain waves is one of the most remarkable of our time.

REAL MEANING

Most of us have used the term “brain wave” at some time or another in a loose sense, without for a moment thinking that such things existed in fact, at all. Yet along comes the everlasting scientist with the news that brain waves are a most necessary function of the organ which some people use to think with.

In this enlightened day, however, we should not be surprised to learn that the functioning of the brain and nervous system seems to be conditioned on the generation of small electrical impulses. After all, doesn't almost everything in nature seem to depend on electricity for its functioning.

Even the very atom of which everything is made is nothing more or less than an electrical phenomenon. What wonder then, that the same laws which govern the atom should govern our existence as a living being.

The brain consists of a vast accumulation of an estimated 10,000-million tiny cells which are interconnected by a network of nerve fibres.

Each of these cells and fibres has a specific duty to perform. None is superfluous to the perfect functioning of the human machine. It is only when something happens to any one of these cells or fibres that the machine becomes imperfect and ceases to function as it should.

It is becoming increasingly clear that our thoughts, actions and the behavior of our internal organs depend on the maintenance of some kind of electrical balance in the brain and nervous system.

The study of brain waves really was begun in 1874, by Caton, but it was not until 1925 that any real advances were made, when a German psychiatrist Hans Berger built an a
paratus with which he detected
the surface of the human head, wav
which emanated from the brain.

In 1934, Professor E. D. Adrian,
Cambridge, studied these research
and brought them to the notice
the medical world.

With the advances made in ele
tronic apparatus, a new instrume
was made and some amazing di
coveries resulted. The instrume
is called by the formidable nan
of electroencephalograph. It co
sists of small metal discs about
half-inch in diameter, which are a
tached to the scalp and from whi
come wires, which are connected
a sensitive amplifier. As the ele
trical impulses generated in t
brain are only in the order of a fe
millionths of a volt, it can be se
how sensitive the amplifier must b

After amplification the impuls
cause a light pen to operate a
describe a line on a revolving dru
of paper. The resulting wavy li
takes the form so often seen on t
screen of cathode ray oscilloscop
or graphs of recording barometers.

The metal discs can be move
over the skull or from any selecte
area.

One of the most pronounced wav
is found on the back of the hea
These have been named “Alpha
waves and occur at a frequency
10 cycles per second. The strengt
of these waves varies from abo
5-millionths of a volt to 100-mi
lionths of a volt.

RELATED TO VISION

Alpha waves seem to have som
thing to do with vision, for th
are most marked when the eyes a
closed or when the brain is restin
The alpha rhythm diminishes wh
the eyes are opened or by a lo
noise, mental strain, exercise or pai

There are two exceptions to t
which may indicate some use of t
alpha rhythm in tests of charact
In people who form mental pictur
when they do any thinking the alp
rhythm is small, while in those w
think in abstract ways the rhythm
large, and in both cases the rhyth

s unaffected by opening or closing he eyes.

These rhythms do not appear in he human until about the fourth ear and attain normal intensity at he age of eight.

One theory is that the alpha hythm is a type of scanning system similar to television, where the electrical impulses produced in the path of the brain that controls vision by the projection of the image from the eye are converted into time sequential brain signals.

Two other types of brain-waves are the beta rhythm and the theta hythm. These are generated in the frontal part of the head, the beta being waves of low voltage and a frequency of 22 cycles per second while the theta waves are only detected during a period of sleep. When theta waves reach an intensity of about 200-millionths of a volt it is usually indicative of disease.

PECULIAR TO PERSON

Like a fingerprint, the brain-wave picture of an individual is absolutely characteristic of the individual and does not duplicate the brain-wave picture of your neighbor. The brainwave pictures of families bear some resemblance to each other.

A most interesting exception to the rule is that of identical twins. Idenical twins are twins of the same sex who become twins because a single ovum split into two parts, each iving rise to a single individual. This is distinct from fraternal twins, who are offspring from two separate va.

The brain-wave picture of identical twins is identical in every way, and t has been established that the ncephalograph can tell with almost bsolute certainty whether twins are, n fact, identical.

One of the most useful aids to nedicine of brain-wave patterns is onnected with the disease epilepsy. t has been found that a person tendng to suffer from this terrible complaint has a very characteristic brainvave pattern. Further it is possible o forecast as much as 24 hours in dvance by means of the brain-wave pattern when this terrible braintorm is likely to break so that the ufferer can be forewarned. Soothng conditions and medicine can then nable the patient to pass through he storm much better than if he were aught unawares. Unfortunately, the patient must have access to a detectng instrument.

PILEPTIC CONDITION

It has been suggested with a cerain amount of feasibility that an pileptic condition is brought about y a breakdown of the insulation beween certain cells in the forepart of he brain. This causes a reversal f the polarity of the electric charge n the cells so that what should be ositive becomes negative and what hould be negative becomes positive. hus the brain is thrown into a conition of oscillation which causes motor-boating."

This latter term is commonly used n radio to describe the plop, plop oise which emanates from a loudpeaker of a radio set which has ecome unstable and is thrown into scillation.

This is a feasible analogy and, as ith a radio set, so the oscillation of e brain continues until the insulation somehow is repaired and the electrical balance restored.

How these electrical impulses are generated in the brain is still largely a matter of conjecture. It is thought that each cell is a small accumulator which derives its charge through some chemical action.

The study of the electrical qualities of nerve fibres gives somewhat of a clue to the matter, but research in this respect is not complete.

If two contacts are placed a small distance apart on the surface of a living nerve and connected through a galvanometer (an instrument used for the detection of electric currents) no current will be detected. If, then, one of the contacts is removed and applied to the inside of the nerve, such as at a cut end, a current will flow, which shows that there is a difference of potential between the inside and outside of the nerve.

by Calvin Walters

It would appear from this that a nerve is capable of generating its own electricity in some chemical way like a dry cell battery. It has been found that the outside of the nerve fibre is at a positive potential, while the inside is negative.

The outer membrane of a nerve allows particles of potassium to pass through but keeps sodium particles out. When a stimulus is applied to a nerve the outer membrane allows sodium particles through and small quantities of potassium particles move out in the opposite direction.

As the potassium and sodium particles are charged it follows that this exchange of particles from outside to inside and vice versa produces a tiny electric current. This current acts then as a stimulus to the adjacent section of nerve in which the process is repeated. The current formed stimulates the next section, and so on.

Thus, from the original stimulus, be it odor of a rose or a kick on the shins, a series of impulses are transmitted along the nerve to the appropriate brain centre, where it is translated into smell, feeling, taste, and so on.

The speed with which these impulses are transmitted along a nerve fibre varies according to the thickness of the fibre and its purpose.

The fibres which conduct messages from the brain to the muscles are of large diameter and these conduct impulses at the rate of 296 feet a second. Inward messages from the organs of feeling are transmitted at a speed of approximately 90 feet a second along thinner fibres.

Some fibres possess a fatty sheath around them. Others which run to the blood vessels and intestines have no fatty sheath. These convey impulses at the slow rate of as low as 2-3 feet to 60 feet a second.

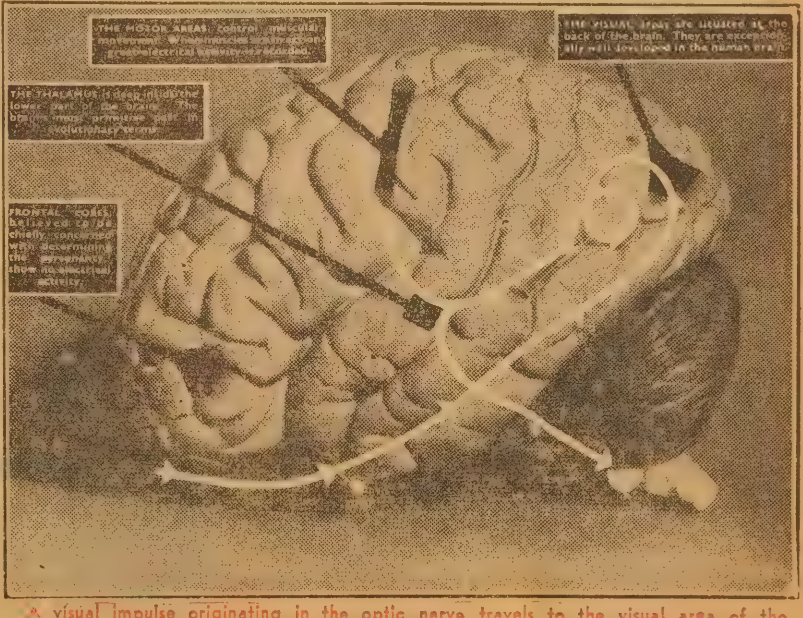
BACK TO NORMAL

Once an impulse has passed along a nerve it follows that the nerve must very quickly be restored to its original condition otherwise no further impulses could pass. This could be very awkward, as, for instance, the sense of feeling would be completely lost with one impulse. A person would be as under a local anaesthetic. A kiss would be one split second of ecstasy.

However, the nerves quickly attain a condition of equilibrium. By some chemical means, the sodium and potassium particles are separated and sent back to their original stations ready for the next impulse.

It will be seen that speed is the essence of the contract and fast is indeed the restoring process.

(Continued on page 89)


THE MOTOR AREAS control muscular movement. When muscles are in action great electrical activity is recorded.
THE THALAMUS is deep in the lower part of the brain. The brain's most primitive part in evolutionary terms.
FRONTAL LOBES believed to be chiefly concerned with determining the personality show no electrical activity.
THE VISUAL areas are situated at the back of the brain. They are exceptionally well developed in the human brain.

A visual impulse originating in the optic nerve travels to the visual area of the brain (right). If the brain decides on a movement, part of the impulse goes to the motor areas and part of it down the spine.

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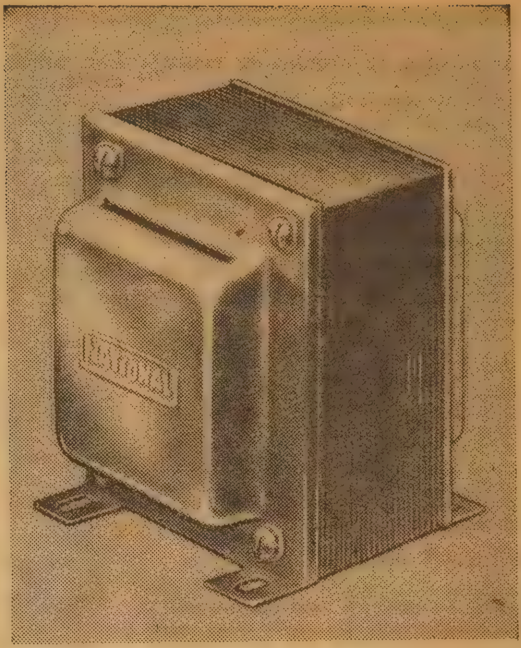

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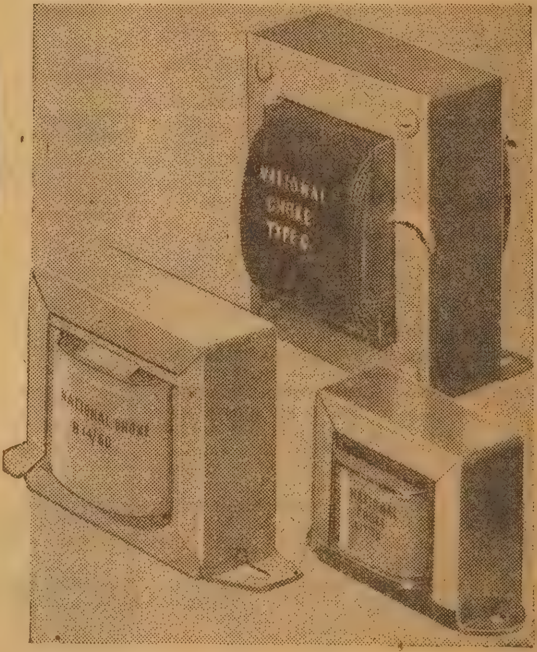

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Technical Review

STATIC ELECTRICITY CAN CAUSE EXPLOSIONS, FIRES

Did you realise that the mere act of getting out of a plastic chair could generate a 5000-volt charge? That the resulting spark could ignite gas or dust particles? Research by the US National Bureau of Standards has established these as quite feasible occurrences.

ELECTROSTATICS, the study of electrically charged bodies, is of fundamental importance to science because many of the basic particles are charged and "coulomb" forces determine many of the properties of matter.

Electrostatic forces are of increasing industrial importance, too, and have been applied to such processes as ore-separation and spray-painting. Painters have found that a tremendous saving is achieved if the object to be painted is charged to several thousand volts.

In other industries, such as air-conditioning, the manufacture of explosives, grain and flour storage, textiles and printing, static electricity can be a distinct hazard.

In a granary, for instance, the air is usually thick with fine flammable grain-dust particles. Grain sliding down a metal chute can result in an accumulation of static charge that, when it discharges in an electric spark, can easily ignite the fine dust particles and result in a fire.

YEARS OF RESEARCH

For many years, the National Bureau of Standards has been consulted by other government agencies on problems arising from the hazards of static electricity. To meet a growing demand for this information, the Bureau is enlarging its research program for establishing and evaluating methods of measurement and for determining the properties of materials and equipment used to reduce the hazard.

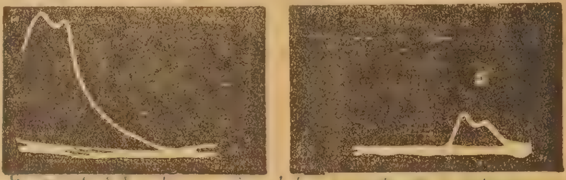
The results of one important phase of the program, an investigation of the conductivity of floor coverings, are being utilised to reduce static electricity hazards in hospitals and in Federal munition plants.

Specifications for conductive floors and other equipment depend on determining the safe limiting resistances between objects.

NBS has participated in determining these limits, evaluating safety factors, and devising suitable methods applicable to field as well as to laboratory testing of flooring and other materials such as coatings and waxes.

A conductive floor need be only a moderately good conductor of static electricity—a resistance of one million ohms or less is ample for this purpose. Such a flooring provides a safe path over which separated electrostatic charges may be reunited as quickly as they were separated.

It is this natural inclination of the charges to rapidly reunite that causes the hazard, creates the spark, or provokes the shock.



Oscillographic records of the potential developed as a person rises from a plastic-covered chair. On the left the insulation is high between person and chair, on the right it has been reduced by a moderate conductor.

To determine the resistance characteristics of flooring, a sample is subjected to different voltages under varying conditions of humidity and temperature. The measuring procedure is also considered in the evaluation.

The flooring resistance is measured with a special resistance-bridge as a function of pertinent variables such as voltage, humidity, and the type of electrode used in making the measurement.

One test on a section of terrazzo flooring showed that, for a variation of from 30 to 500 volts, the resistance of the sample decreased from about 4.5 to 1.5 megohms. A low resistance flooring-conductive linoleum changed from almost 3 megohms at 40 volts to less than 10,000 ohms at only 150 volts.

An accompanying phase of these experiments is a determination of the actual safe upper limit of resistance.

For example, tests show that voltages as high as 5000 volts can be developed by such common, everyday occurrences as getting up from a plastic-covered chair.

Oscillographic records, however, indicate that if the resistance between the person and the chair is less than 20 megohms, the voltages will not exceed 300 volts. This is less than the minimum sparking voltage in air and is thus not hazardous.

The magnitude of the electrostatic charges produced by separating objects depends on the material involved, their intimacy of contact, and their surface resistivities. However, many accidents do not arise from these direct effects but rather from the secondary effects resulting when the static electric charges are reunited.

For instance, the electric shock experienced when a charged person touches a conducting object, while generally merely annoying, can cause serious damage if the person is precariously balanced on top of a ladder at the time he receives the minor shock.

Also, the energies in electrostatic sparks may be large enough to ignite flammable gases or vapors that may be present in an enclosed room.

Likewise, the "precipitation static" caused by corona discharges from highly charged aircraft in flight has been found to be responsible for serious interruptions to radio communications.

The most serious hazards, those of possible ignition of flammable gases or dusts, can best be mitigated by reducing the flammability or eliminating exposure.

OTHER SOURCES

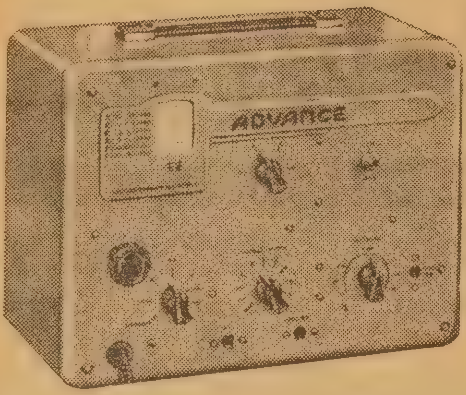
This also reduces the hazard from other sources of ignition, such as arcs from electrical equipment or the presence of hot bodies in the hazardous area.

These measures, when coupled with the exclusion from the area of materials such as plastics, wool and rubber, which have high electrical resistivity and "generate" high electrostatic charges, are often sufficient to reduce the hazard to a negligible value.

More elaborate methods of mitigation depend upon reuniting the charges as fast as they are separated

(Continued on Page 95)

Advance SIGNAL GENERATORS



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Modulation:	30% at 400 cycles
R.F. Output:	1 uV to 100mV, continuously variable through 75 ohm matched transmission line. A steady output of 1 volt is also provided through a separate socket. Using the termination pad, output impedances of 37 ohms, 10 ohms, or 10 ohms through a standard 'all-wave dummy aerial may be obtained.
A.F. Output:	Variable 0-12 volts at 400 cycles.
R.F. Leakage:	Total stray leakage less than 3 uV at 100 Mc/s.

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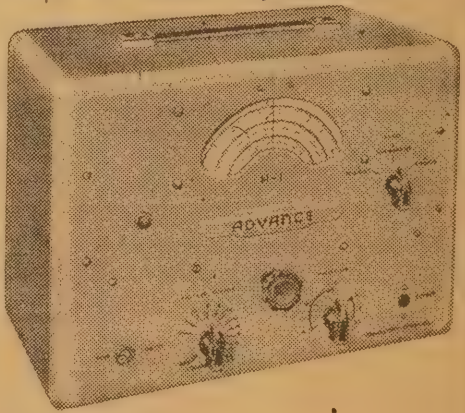
"Advance" Signal Generators are designed and manufactured as precision instruments. The same high standard of workmanship is maintained right throughout the range, from ordinary radio service models to sub-standard types for research and laboratory use. They are widely used by Australian Government Departments and Defence Services as well as industry generally.

The two models illustrated are companion instruments designed to fulfil the needs of radio service and communications engineers and, between them, provide complete radio and audio frequency signal sources for all normal requirements. They are keenly priced and are fully guaranteed.

Write for detailed specifications

A.F. GENERATOR TYPE H1

Range:	15 c/s to 50,000 c/s
Accuracy:	Frequency calibration plus minus 1% or plus minus 1 c/s
Output:	Sine wave—200 uV to 20 volts plus minus 1 db Square wave—400 uV to 40 volts
Rate of rise of square wave:	Less than 3 microseconds to reach 90% of peak value at 10 Kc/s
Distortion:	Less than 1% at 1,000 c/s



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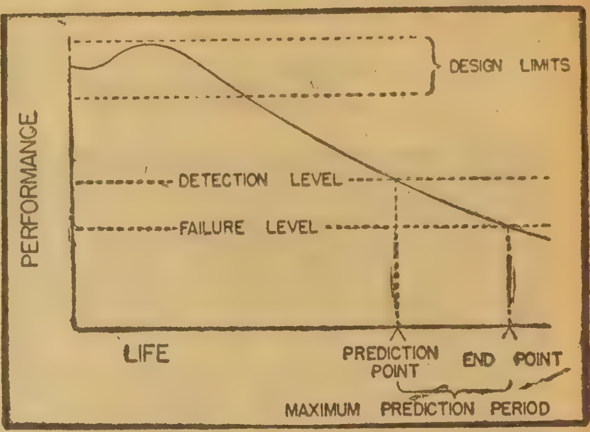
PREDICTING FAILURES IN ELECTRONIC EQUIPMENT

The US National Bureau of Standards is at present investigating the possiblility of predicting equipment failure by simple routine tests in the field, thus allowing corrective steps to be taken. Such precautions are becoming essential because of the increased complexity of equipment and overall dependence on it.



Typical curve representing the change in performance level with service life of electronic equipment. Regular prediction tests could anticipate many failures.

IN an NBS technique, experimentally evolved, a maintenance nan plugs a protable failure-prediction unit into the slightly-modified quipment to be checked and turns multipoint selector switch, a red ight flashes on to identify stages hat have deteriorated below safe evels and have become prospective auses of equipment failure.

In accelerated-ageing experiments n a military radio receiver, the ureau has succeeded in predicting majority of failures many hours efore they occur.

As applications of radio and elecronic equipment continue to increase n extent and importance, problems f maintenance and reliability beome more serious.

MILITARY EQUIPMENT

This is particularly true of miliary electronic equipment. In adlition to depending on it for miliary communications, the Armed orces rely on electronic equipment or radar detection, for the autonatic aiming, firing and detonating f weapons and missiles, and for umerous instruments and control pplications.

The inevitable complexity of this quipment augments the danger that ailures of components will cause ailures at critical times. Although nuch progress has been made toward etter electronic dependability the eliability of present-day electronic quipment still leaves much to be lesired.

In some large and highly specialsed electronic installations, such as he Whirlwind computer, valuable neans for automatically detecting narginal stages have been built into he equipment. However little study eems to have been made of the ractical possibility of detecting inipient failures by simple routine hecks with portable test equipment.

TWO THOUSAND TUBES!

The fact that large bombers may se some 2000 vacuum tubes suggests he magnitude of the problem of ataining the reliability in military lectronic equipment.

It has been estimated that a typial home television receiver, with bout 20 tubes, averages one tube ailure for every 1200 hours of operaion; with the same rate of failure, plane with 2000 tubes would have ne failure every 12 hours. Yet nuch more severe environmental onditions in the plane increase failre probabilities.

Either sudden or gradual failure of tube or other component may cause ailure of electronic equipment. Alhough improvement of quality seems o be the only way to reduce sudlen failures of components, surveys ave indicated that at least half of all equipment failures are produced by gradual failures of components.

The NBS work has been concerned with practical means of spotting these gradual failures before the equipment becomes inoperative.

In multistage equipment it is impossible in general to detect such incipient failures by input-output performance measurements, because the tolerances of an over-all measurement will usually mask the performance decrease of one stage.

Daily variations in measured gain of a typical piece of equipment are greater than the change caused by the gradual deterioration of one tube in one stage; as the tube continues to deteriorate, the time at which impairment of over-all performance becomes detectable may virtually coincide with the time at which overall failure occurs.

INDIVIDUAL TREATMENT

Successful failure prediction, therefore, requires that the condition of each important stage or small group of stages be established individually. The designer of electronic equipment must allow certain designs tolerances of any type of component. Component performance may vary both positively and negatively with time, and the designer must allow for these drifts as well as for initial spread.

Tube failures constitute by far the most common cause of electronic equipment failure, and the experimental NBS failure-prediction system depends primarily on the sensing of decrease in tube transconductance of critical stages.

This is done by operation of the tube as a resistance-coupled amplifier, with a 3000-cycle signal applied, and the sensing of whether or not the voltage gain has fallen below a predetermined limit.

This test also permits detection of changes in components other than the tube if the changes affect the gain of the stage.

In addition, provision is made for voltage and current measurements and for checking capacitors for leakage, although in the equipment studied practically all the failures have been tube failures detectable by the voltage-gain check.

The military receiver selected for experimentation, an 18 stage guard-channel receiver, required only slight modification for adaption to the failure-prediction system. The circuits were first examined for sensitivity to weak and gassy tubes. The sensitive stages comprised the r-f amplifier, first mixer, high i-f amplifier, second mixed, two stages of low 1-f, two crystal oscillators, and two frequency multipliers.

LESS CRITICAL

Insensitive stages were signal and avc detectors, audio and avc amplifiers, series and shunt noise limiters, and avc gate. Modification of wiring was sufficient to permit checks on the 10 sensitive stages. Changers consisted chiefly in provision for breaking grid and plate return leads to permit insertion of an audio signal and measurement of gain.

Necessary connections were made to a multi-point connector into which the plug from the failure-prediction unit could be inserted. Circuit changes entailed use of about 7.5 pc additional components, mostly capacitors and r-f chokes; wiring and parts were all fitted without difficulty into available space in the receiver.

The experimental NBS prediction test unit includes a 3000-cycle oscillator, voltage-sensing circuits, a leakage detection circuit, and an alarm light. As the main selector switch is rotated different predetermined levels of audio signal are applied to the grid of each stage.

SIMPLE OPERATION

Each input signal is preadjusted so that, if the gain of the stage has changed by more than a safe amount, the voltage-sensing circuits will actuate the alarm light. After the test unit has been plugged into the receiver, the operator needs only a few seconds to rotate the selector switch and discover any weak stages.

In laboratory evaluation of this failure-prediction system, 1000-hour accelerated-ageing tests were run at the bureau on six of the modified receivers. Prediction checks were made at five-hour intervals.

A total of 79 tube failures occurred in the six 11-tube receivers

(Continued on Page 93)

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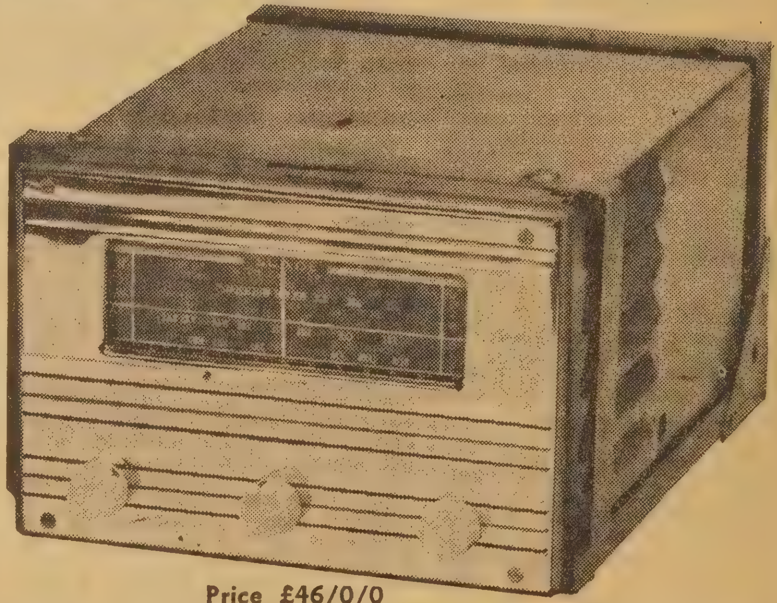

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COLORS MUST BE RIGHT FOR MONOCHROME TV

Imagine a television stage scene as it would be viewed from the TV studio: The set designer has executed the background in the soft tones of greyed gold; the star is wearing a gown of ultramarine blue; the leading man is clad in a suit of medium grey, and the dominating piece of stage property is a divan covered in a brocade of warm green.

*By A. W. PROTZMAN **

The author (left) measures the temperature of the studio illumination as Cliff Stiegelbauer holds a red-orange card against a grey scale. The comparison shows that this particular hue will be reproduced on TV screens as Munsell No. 7 grey

TO the studio audience, the visual picture in color is a satisfying one, impressive and in the proper mood of the play. But strangely, the thousands who are watching the same scene on their home TV receivers in monochrome are left cold, unresponsive, unimpressed.

To them, the video screen picture—in sharp distinction to the scene viewed by the studio audience—appears flat with an almost complete absence of tonal contrast between the costumes of the cast and the stage and properties and scenery.

In this imagined scene, some vital change has taken place between camera and receiver screen to nullify the best work of designers, producers and cameramen.

Unfortunate situations similar to this one have not been uncommon in television. The basic cause was the inability of the TV camera to convert the different colors of the scene into correspondingly contrasting shades of black and white. In the particular setting just described, the greyed gold, ultramarine blue, grey and green would have appeared on viewers' screens as a monotonously uniform tone of slate grey.

But NBC has taken positive steps to see that such incongruities won't happen again on its network. After months of methodical labor, the author and Cliff Stiegelbauer, NBC Supervisor of Design, have completed preparation of a reference book which removes all element of chance in selecting colors and color combinations for the most effective black-and-white TV presentations.

WON'T HAPPEN AGAIN

Preparation of a reference book of this kind would have been useless in the early days of television when the iconoscope was the standard camera tube, because the "ike" was not stable in its color response.

Different tubes responded in different ways. But the RCA image orthicon—the present standardised camera tube—is being mass-produced with a dependable and specific spectral response. This response was used as the starting point for the NBC color charts.

When the study of color versus black and white was begun, it was essential first to establish a workable range in the grey scale, that is, from light grey to near black. As a basic source of comparison it was decided to utilise the accurate and standard Munsell Grey Scale.

The Munsell system grades tones from black to white and arbitrarily numbers them from 1 to 9.5, but because the television system cannot successfully tolerate this wide contrast, it was necessary to confine the range between No. 2 black to No. 8.5 white. Munsell No. 2 black reflects only 3 pc of the light striking it while the No. 8.5 hue, called "television white," reflects 63.5 pc of incident light.

By actual tests it was found that a video picture could be more accurately reproduced if the reflectance of scenery, whether in color or in monochrome, were held within this restricted contrast range.

Preparation of the NBC Color Book was a long, tedious job. There were 192 colors to test and each color was broken down into four tints and three shades.

In its final form, the NBC book—which is not available for general distribution—consists of 14 pages, ten of which carry inch-square chips of graded color ranging from violet-blue-violet to light yellow. On each page, beside the related group of color patches, is a Munsell chip embodying the shade of grey equivalent to the shade that will be reproduced at the black and white receiver when any hue or tint of the color group is televised.

As a reply to the obvious suggestion that scenery could be painted in the desired greys and costumes chosen in the same manner, rather than bother with colors, it should be pointed out here that the visual effects achieved by the use of color instead of grey do a lot to brighten the spirits of performers.

Video directors have learned that actors are more at ease and happier in surroundings of normal colors. (From Radio Age, Oct., 1952.)

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* *Technical Production Director, National Broadcasting Co.*

* * *

THE SHAPE OF WINGS TO COME

(Continued from page 11)

be made so that any twisting of the main wing will not cause reversal of that conrol. A difficuly does arise, however, in that the thin tip section has a poor lift at low speed, and therefore flaps are needed on the leading edge to increase the camber and improve lift.

The delta wing is an entirely different approach. Where the other designs adapt themselves to twisting effects by ensuring that they are harmless, the delta combats these problems. It meets most of the troubles by its very geometry. Since it is a complete triangle, it automatically has a larger wing area than any swept wing of similar span. The huge width of the root gives exceptional structural depth, even where the thickness is less than 10 pc. The leading edge sweep is normally greater than that on present-day swept wings.

These features ensure good high-speed and high-altitude characteristics, structural stiffness, and ample stowage space for fuel, engines and under-carriage inside a clean envelope, with the minimum of drag-producing excrescences. Furthermore, the very broad wings, with a span less than three times the average width, give exceptionally good lift at low speeds.

Without publication of the performances achieved, it is impossible to know which compromise of the four approaches makes the best aeroplane. Each designer appears confident that his own approach is the best, but all too often the expert's enthusiasm makes him blind to the virtues of others. Only time, and possibly performance under operational conditions, will tell which is the best.

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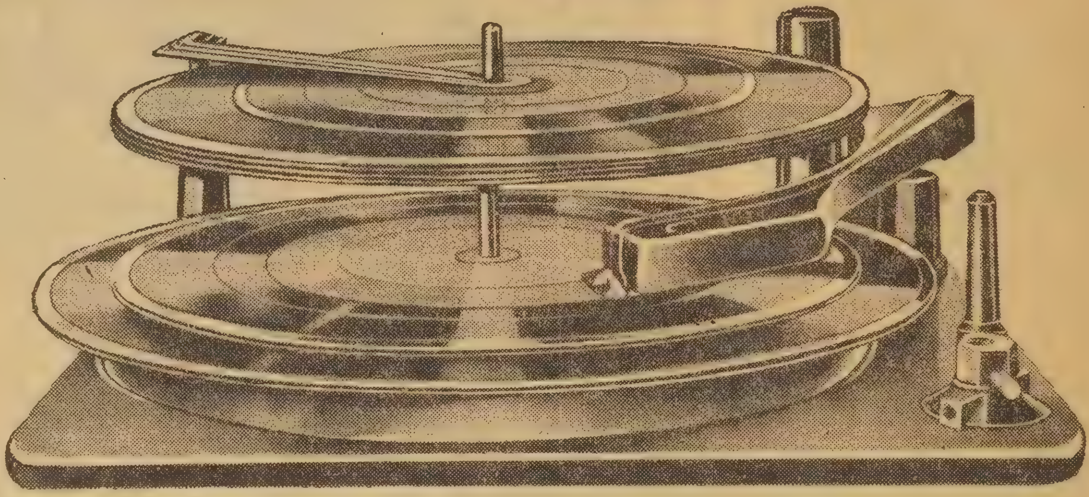

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NEWS AND VIEWS OF THE MONTH

Man versus locust

ONE of the most significant air battles of the present day is being fought out in Africa between man and an insect—the locust. In Kenya, Auster aircraft of the United Nations Food and Agricultural Organisation, are fighting the locusts with DNOC and DDT and combat esults are being keenly studied.

The tactics used by the enemy re well known to the UN anti-locust squadron. First, he flies not alone but in a swarm, which forms a blanket some two to three miles ong, a mile wide, and several inches hick. It travels with the wind in a drifting irregular motion, and may move some ten to forty miles in one day. At night, the swarm is grounded. It is then that it does he damage. When it becomes airborne the next morning, every crap of vegetation has disappeared from its landing-ground.

Anti-locust pilots pick this time to go into battle, around dawn, when he enemy has just taken off — if praying started earlier only the top ayer of locusts would be caught. From ground reports or aerial reconnaissance, the aircraft locates the warm and flies along at the same evel, preferably in among the locusts.

Wire meshes fitted to the aircraft keep the locusts out of the air intake, and the vision clear. The spray has no immediate visible effect, but over the period from one hour to two days later, the swarm is grounded for good. If a stronger spray were used, its vapor would ground the pilot, too.

★ ★ ★

Electronic hammer

ELECTRONIC work-hardening of metals by means of an electronic "hammer" may become quite common by means of a "statitron," which, unlike the cyclotron, does not smash atoms, but rather displaces them; hence, it is capable of changing the physical properties of a piece of metal.

The new machine was developed in the Downey, California, plant of North American Aviation, Inc., headed by Dr. Donald Eggen. An endless insulated belt, travelling at 3000 feet per minute, conveys electrons to the top of the statitron, where they are stored on the metallic dome, building up a tremendous accumulation of charge.

When released by a hot filament, the accumulation gains speed down an evacuated accelerator tube. About 60 thousand billion electrons per second strike the experimental target at the base of the tube with a speed of travel which is approximately that of light—186,000 miles per second.

The atoms in the metal are hit with such force that they are displaced, the metal being put in the same condition as that which occurs with work hardening.

The statitron produces no radioactivity, but it does emit a very dangerous radiation background of several million times that which is considered to be tolerance for the human body. In fact, these radiations are very hard x-rays, which are capable of taking interior pictures of very heavy steel samples—such as a piece of steel two feet in diameter.

Because of this radiation, the walls of the statitron room are very thick concrete, and the door is of heavy lead. The building is electrically interlocked, making it impossible for the generator to be turned on when anyone is in the room.

★ ★ ★

Watch new drugs

A WARNING that apparently all the newer drugs for epilepsy can dangerously depress the blood-forming action of the bone marrow appears in the Journal, American Medical Association.

The warning comes in a report, by Drs. Allen E. Hussar and Helen B. Rogers, of the Veterans Admin-

POPULAR SCIENCE QUIZ

Q. Why does friction produce electricity?

A. Actually the question is incorrectly framed. All matter is considered as being electrical in make-up and, outside of nuclear physics, "matter can neither be created nor destroyed." Electricity is really the transformation of one form of energy into another form.

Matter is made up of atoms consisting, basically, of a nucleus of positively-charged protons surrounded by negatively-charged orbiting electrons. At rest, such matter is neutral, the positive charges being balanced by the negative charges.

However, if the balance of charges is upset, the matter will carry a predominance of one "type" of charge. This is the origin of "static electricity." From physics experiments at school, we learned that if we rub a rubber or ebonite rod with fur or a glass rod with silk, each of the rods will attract small objects such as scraps of paper. This is due entirely to the rearrangement of the charges—the ebonite rod receiving electrons from the fur leaves the fur positively charged and itself negatively charged. The reverse is the case with the glass rod and the silk.

In circumstances which allow the charges to build up, there is a tendency to restore equilibrium resulting in a electrical discharge taking place through the air. Running a comb through one's hair on a dry day can produce this condition.

In nature, this condition exists, on a very much larger scale, of course, during thunderstorms when the lightning flash and the accompanying clap of thunder is merely the discharge through the air of the huge charge potential built up among the clouds and between the clouds and the ground. Dust storms are another instance of static electricity being produced in nature.

Q. Has aluminium been used for large-scale structural work since the war?

A. Yes. Outside the city of Arvida in the aluminium-producing area of Quebec, the Saguenay River is spanned for a distance of 300ft by the only aluminium arch in existence. Completed in June, 1950, the bridge will serve as a large-scale test of structural aluminium.

Since aluminium weighs only one-third as much as steel and the high-strength heat-treated aluminium alloy used is as strong as structural steel, the use of aluminium made possible a two-thirds reduction in the stresses from the weight of the bridge itself, with a corresponding increase in load-carrying capacity.

The light-weight metal is not only easier to transport, fabricate and erect, but aluminium structures do not require painting.

The new liner United States is constructed largely of aluminium alloys.

Q. What is the smallest known star?

A. Scientists at the University of Minnesota have announced the discovery of the smallest known star and given it its catalogue number of L886-6. Only 2500 miles in diameter, not much larger than the moon and only about one-third as large as the earth, the new star is located in the USA winter-evening Milky Way about midway between the Big and Little Dog stars. It is far too faint to be seen without a large telescope, having only one 60,000th of the sun's candlepower. At its distance of 25 light years, it glows so feebly that it is 10,000 times too faint to be seen with the unaided eye.

According to the scientists, the new star is 40 pc heavier than the sun, from which it follows that the average material of the star is about 55-million times as dense as water. As much of the star as you could put into a matchbox would weigh 1000 tons here on earth.

A star as dense as this has an enormous gravitational attraction for anything on its surface—about 4-million times as great as the attraction which we experience to the earth's surface. A man weighing 150lb on earth, the astronomers estimate, would weigh several hundred thousand tons on the surface of the tiny star.

MAGRATHS' *Monthly* BULLETIN

APRIL, 1953

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istration Hospital, Tuscaloosa, Ala., of the first known direct evidence of such bone marrow damage from phenthenylate, also known as "thiantoin." The patient developed the blood disease, agranulocytosis, but recovered when the drug was stopped.

Frequent blood cell counts should be made, the VA doctors advise, when any of the newer epilepsy drugs is used.

Only one which apparently does not interfere with blood cell formation in the bone marrow is the oldest of the group, diphenylhydantoin sodium, known also as dilantin sodium.

* * *

Human conveyor belt

CONVEYOR belt sidewalk, 85 feet long and two feet wide, has been in experimental use in Akron, Ohio, for a year to obtian scientific data which may find application in the proposed subway shuttle system between Times Square and Grand Central Station, New York City.

The type of "moving sidewalk" used, developed and installed by Goodyear Tyre and Rubber Company, looks much like the moving stairs now widely used, but lies flat on the earth. Like the escalator, it has a moving handrail to be grasped by the passenger. It is driven by electric motors geared for speeds from less than one mile to five miles an hour.

The fast-moving section of the moving sidewalk, 68 feet in length, has an entrance section and an exit at its ends. Passengers entering step on to the entrance belt while walking at one and a half miles per hour. Associated with the belt sidewalk were many types of instruments to record the data desired.

* * *

Warns pilots of stall

A DEVICE to indicate when a plane is about to go into a stall by ionising the air stream around the wing has received a patent.

The stall detector takes advantage of the fact when a plane's wing is in normal position, the air flows ack along the top of the wing, clinging close to the surface. When it is in a stall position, the air stream leaves the surface of the wing and, close to the wing, a state of turbulence exists.

The inventor, Paul J. Campbell, Middletown, Conn., provides a device which ionises the air at the eading edge of the wing. Toward he rear of the wing, a detector icks up evidence of the ionised air. When the plane approaches a stall, he detector no longer can pick up he ionised air, thus indicating the pproaching stall to the pilot.

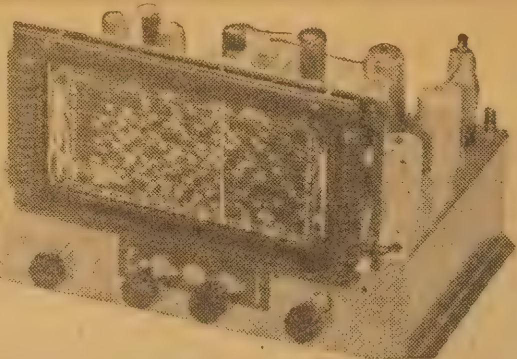
* * *

Sunburn rule

A TIME schedule sun bathers can follow to avoid painful burns nd blisters has been worked out by r. Lewis R. Koller, of General lectric Research Laboratory. Here t is.

First, note the time it takes for he summer sun to make your skin faint pink. Then limit your sun athing to two or three times that eriod.

Five times that period can give ou a painful burn and 10 times he pink-tinting period will result n blisters.



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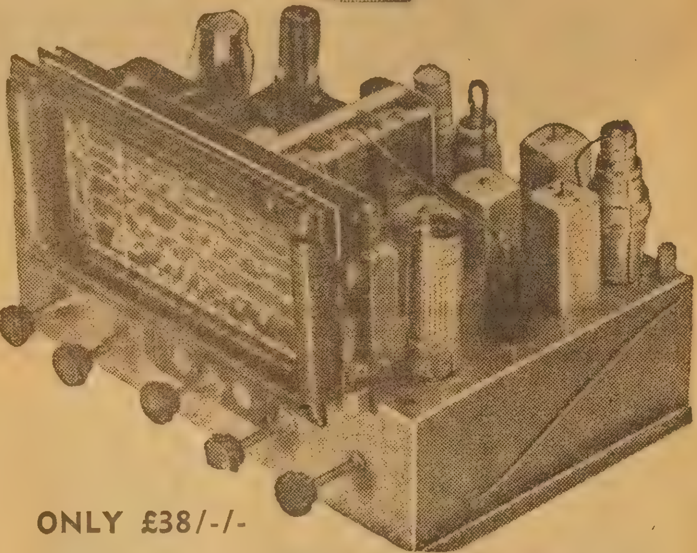

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5 valve with 12" speaker £21/10/- (suitable for phono pick-up only 8 watt output).

6 valve with 12" speaker £25/-/- (suitable for phono pick-up and microphone 12 watt output).

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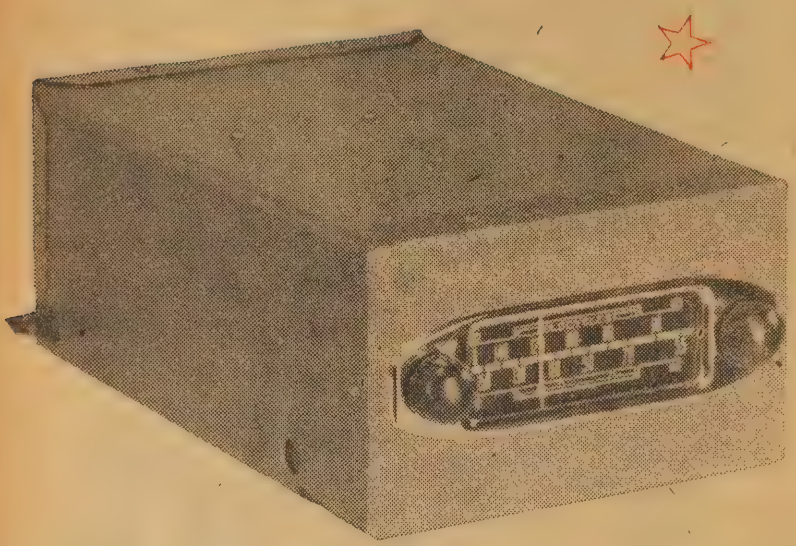
NEW SINGLE-UNIT CAR RADIO

Here is another set which is destined to be a winner—a four-valve version of the widely acclaimed Radio and Hobbies' "Karset". Built as a single unit and only two-thirds the original overall size, this new set is designed for the man who wants something simpler and cheaper, yet still good!



The four-valve "Karset" as it appears in its single case and minus only the speaker. Tested in the city area on a car-type aerial both local and country stations are available at good strength. The absence of an RF stage is not apparent under these conditions.

OUR first Karset project, published back in May, 1949, was embarked upon with some hesitation because we were not then certain that home constructors, with all their enthusiasm, could overcome all the likely problems of vibrator hash, ignition noise and mechanical rigidity. This not to mention aerial and installation problems in the car itself.

As it turned out, however, the idea of a home-built car set caught on like a prairie fire. Only the Little General topped it for popularity, measured in terms of kits sold by the various trade houses.

FEW TROUBLES

Nor were there any serious repercussions from disgruntled readers. Some reported slight residual vibrator hash and ignition interference which, for the most part, they weren't very worried about, because it was only apparent in remote areas.

Then came the 1952 Karset and the same story was repeated. Readers bought the parts, built and installed the sets and seldom had any other remark to make except "goodo," or its equivalent in other social circles.

We expect precisely the same to happen with this set. You can build and instal it and be almost certain that it will play all the local stations forthwith and without difficulty.

A few readers might have some evidence of vibrator hash but this is inevitable. Vibrator sets are like that, being sensitive to variations in wiring and component layout. Some, too, will have more difficulty than others with ignition noise but the same remark is true of all cars and all car radios.

by Raymond Howe

If you are not among the fortunate ones, you have to do some "fiddling" to wipe the last vestige of background, when listening to distant stations. In the metropolitan area, however, there should never be any bother.

Well then, what's the story behind this new, smaller Karset? Is it likely to be a compromise design? In the vernacular, a bomb? We'll answer that.

Physically, the story is obvious. The two earlier "Karsets" were housed in twin metal boxes, one containing the receiver proper, the other the power supply. The boxes could either be strapped end-to-end to form a single narrow unit, or mounted separately where the space was more restricted.

Common practice in most small cars was to mount the receiver in the glove box or under the dash, putting the power supply in any available odd corner.

The same procedure could have been followed with this set but we reckoned that, if the size of set and power supply could be cut down sufficiently, they might be installed in a single box, thereby reducing both the complexity and the cost of the finished receiver.

WHICH STAGE?

That we succeeded, you can judge for yourself.

Electrically, the obvious step was to drop off the RF stage, since this would eliminate a valve, a coil and one section of the gang, together with other sundry items. To eliminate one audio stage would not have meant such a saving. But can we afford to drop the RF stage?

A few years ago, the answer to such a question would have been an emphatic "no" and some of the then available examples of 4-valve car sets were witness to the truth of this.

However, there has been a big improvement since then in the performance of both coils and valves and it isn't too far from the truth to say that a modern, well-designed set without an RF stage is on a par with the old models which included one.

So there it is. If you want a set that will play music as you drive around the town, or to the beach at weekends or only half-way to "Timbuctoo," this one will do the job.

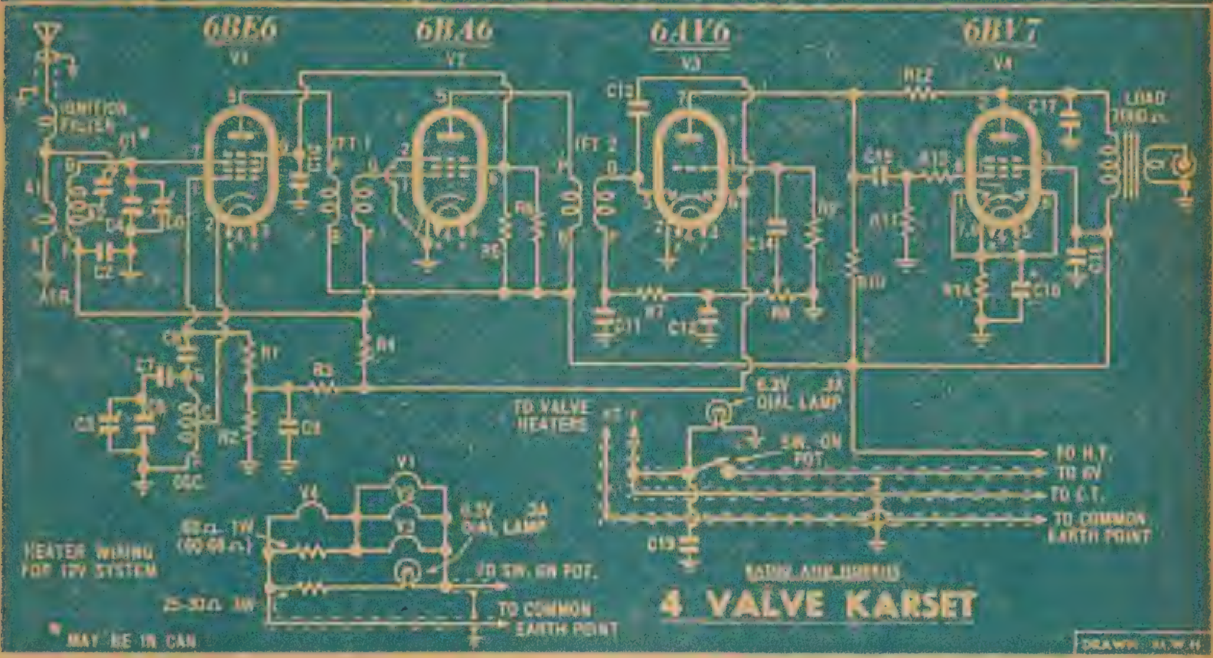
But, if your interest lies in the far south or the deep north, or in Timbuctoo itself or out beyond the black stump, go for the five valve job which has RF stage and modern components as well!

Now for the circuit:

The signals from the car aerial arrive at the input socket through shielded cable where they are fed through a small ignition filter coil to the primary winding of the aerial coil. This filter coil seems to be standard fitment in most car radios.

All other factors being equal, the reason for the good performance lies largely in the use of a special high-gain car aerial coil.

FOUR-VALVE CIRCUIT GIVES HIGH PERFORMANCE



Here is the circuit of our new "Karset," with the coded parts list underneath. The circuit of the vibrator unit appears on page 29. After completion, the two units are wired permanently together without an intervening plug. It is essential, for proper results, to use a coil kit especially designed for a car radio and including a high-gain aerial coil.

There appears to be some diversity of opinion among manufacturers as to the feasibility of producing such a coil in the miniature size. However, we have made provision on the chassis for the aerial coil in a standard size can on the assumption that it is easier to manufacture such a coil in a standard can than in a miniature can.

This brings up the point of the 100 pf capacitive coupling between the primary and the secondary centre-tap and shown as C1 in the circuit diagram. In the large size can there is sufficient room to carry the capacitor for internal connection, this being the reason why it is not shown on the coded underchassis photograph. With the miniature aerial coil, it needs to be connected externally between the connection points provided.

From the 6BE6 converter grid onward, the circuit is very much the same as that of the 1949 and 1952 Karsets and thus warrants little comment. The essential difference is that the screens of the 6BE6 and the 6BA6 IF amplifier are paralleled and

PARTS LIST

1 Chassis 5¾in x 3⅝in x 1in.

1 Box 6in x 3½in x 8½in long with inside partition plate with ½in fold.

1 Base plate 5¾in x 3¼in for vibrator supply.

1 Car radio coil kit comprising high gain car aerial coil with tapped secondary ignition suppressor coil, Osc. coil to suit 6BE6 valve, two miniature 455 Kc IF transformers.

1 Miniature dial (MSL/48 B/C) to suit gang.

1 Miniature 2-gang tuning capacitor (C4,C5).

2 Gang section trimmer capacitors (C3,C6).

1 6 or 12 volt small size vibrator transformer with 250v. 55mA secondary.

1 Synchronous vibrator cartridge, 6 or 12 volt to suit transformer.

1 15 henry 60mA filter choke (L1).

3 7-pin miniature valve sockets with shield cans.

1 9-pin miniature valve socket, 1 6-pin valve socket for vibrator.

1 Standard RF choke (may be in coil kit).

1 7in or 8in speaker, 1 miniature 5000-7000 ohm speaker transformer.

2 Chassis-mounting single contact plug and socket assemblies (car radio type).

VALVES

1 6BE6, 1 6BA6, 1 6AV6, 1 6BV7

CAPACITORS

C1 100 pf.
C2 .1 mfd.
C3 Trimmer.
C4 Gang section.
C5 Gang section.
C6 Trimmer.
C7 425 pf 5 pc mica.
C8 100 pf.
C9, C10 .1 mfd.
C11, C12, C13 100 pf.
C14, C15 .01 mfd.
C16 miniature 25 mfd 40PV electrolytic.
C17 .005 mfd.
C18, C19 .25 mfd.
C20, C26 .01 mfd.
C21, C23 8 mfd 525PV chassis-mounting electrolytics.
C22, C25 .5 mfd.
C24 4700 pf.

All 100 pf except C8 are UCC miniature. All tubular capacitors except electrolytics are TCC.

RESISTORS

R1 .02 meg.
R2 3000 ohms.
R3, R4 1 meg.
R5, R6 .025 meg.
R7 .1 meg.
R8 .5 meg. potentiometer with switch.
R9 10 meg.
R10 .25 meg.
R11 .5 meg.
R12 2 meg.
R13 5000 ohms.
R14 150 ohms.

SUNDRIES

2 Small knobs and felt washers, 1 6.3v .3A dial lamp, 1 5-tag and 2 3-tag mounting strips, 16 gauge enamelled wire for RF chokes (may be in coil kit), PT1M coaxial cable for aerial lead, about 3yd shielded wire, 1 ½in threaded stand off pillar, aluminium scrap for brackets, 2 ¼in and 3 ⅜in i.d. rubber grommets, 4 rubber mounting grommets ⅜in i.d., 4 1¼in by ⅛in bolts for vibrator base plate support, flat and lock washers, self-tappings screws, nuts, bolts, solder, solder lugs, hook-up wire, spaghetti, cable for battery connection and cable-mounting fuse holder (if desired).

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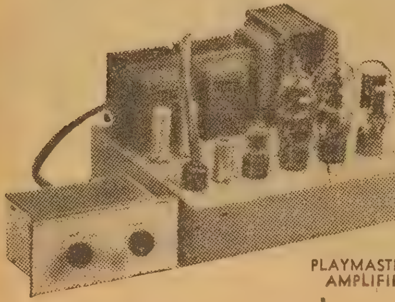
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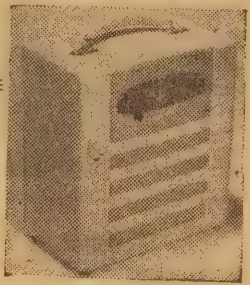
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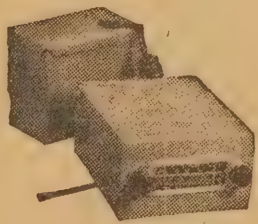
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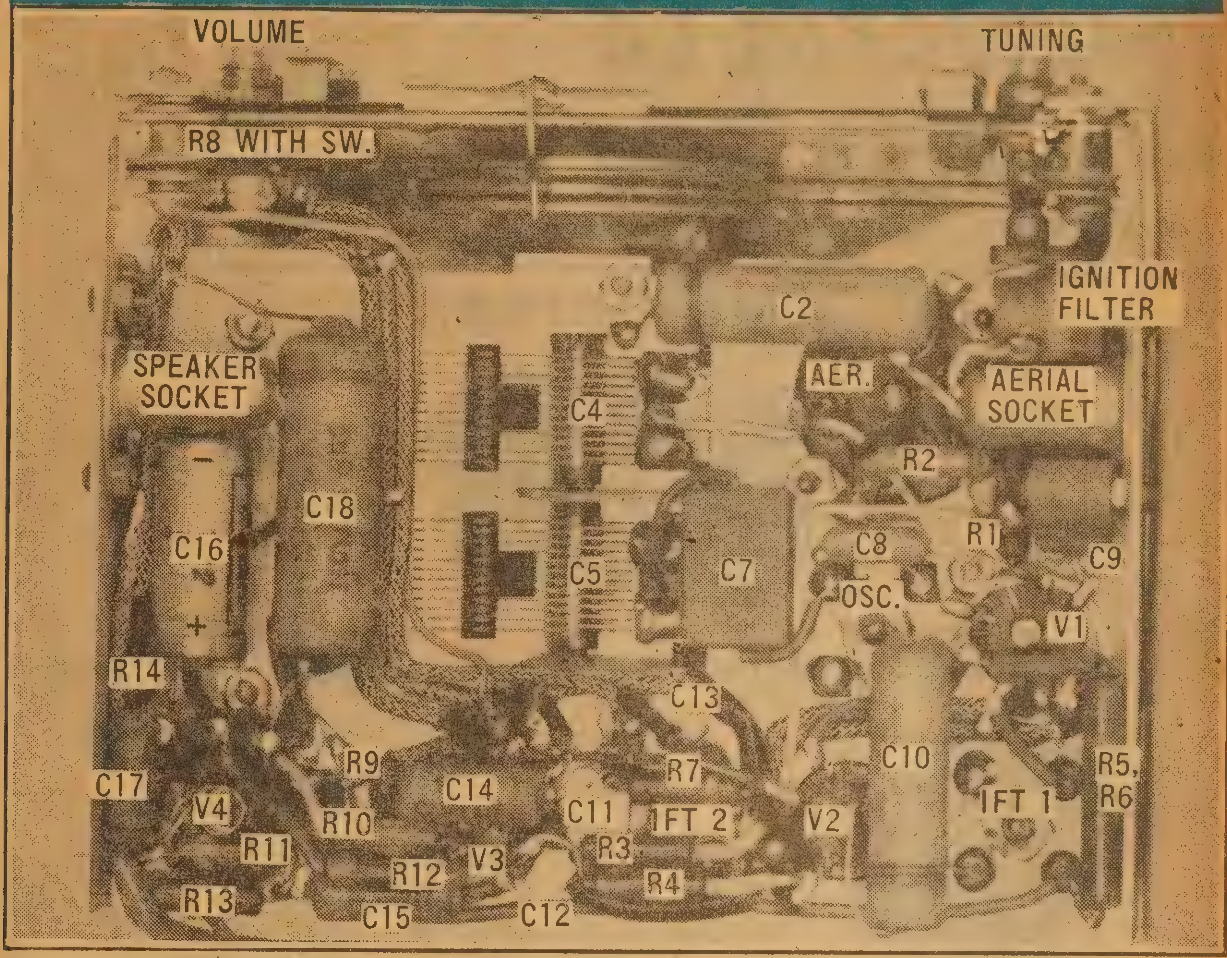
UNDERNEATH VIEW SHOWS POSITION OF ALL PARTS



A full-size underneath view of the chassis. While it is impossible to trace all the wires, the code letters indicate the position of all components. We suggest you save yourself worry by selecting similar miniature components and following our layout in detail.

fed through a common dropping resistor, and the AVC feed points of these two stages are parelleled and coupled through a common decoupling network to the AVC line.

SCREEN VOLTAGE

With "no signal" conditions, the screen voltage is about 96 volts. When tuned to a strong station, it is about 105 volts.

Jumping right over to the output stage, a parasitic suppressor resistor of 5000 ohms is wired in series with the 6BV7 grid connection. In the same interest we chose to use a miniature speaker transformer on the chassis so that the "hot" plate lead of this valve could be kept short. The low impedance voice coil run to the speaker does not normally require shielding.

As far as we know, the only transformer types which will fit into the available space are the Rola E type and the Jensen replacement type. Although it is advisable to select a transformer which will present the voice coil impedance of the speaker as a nominal load of about 7000 ohms to the 6BV7, you would "get away with" a load impedance figure of from 5000 ohms to about 8000 ohms.

Check on this transformer before you buy your speaker. If you are unable to procure one, purchase the speaker with a suitable transformer attached and connect it to the set through a short length of twin shielded cable, earthing the shield to the chassis of the set. Naturally, you will not be able to use the single-contact plug and socket assembly shown in the photograph if you have to bring out the plate lead and B-plus for this purpose. You may be able to obtain or devise some other suitable plug-in connection.

So much for the set itself. The vibrator power supply and interconnection wiring differs from that of previous Karsets. It has to do, of course, with the different constructional approach.

Resistor color code

VALUE	BODY	END	DOT
10 meg.	brown	black	blue
2 meg.	red	black	green
1 meg.	brown	black	green
.5 meg.	green	black	yellow
.25 meg.	red	green	yellow
.1 meg.	brown	black	yellow
.025 meg.	red	green	orange
.02 meg.	red	black	orange
5000 ohms	green	black	red
3000 ohms	orange	black	red
150 ohms	brown	green	brown

To keep the overall length of the set down, it was necessary to mount the vibrator on its side. However, no standard transformer was available which would allow us to do this. We sought the co-operation of a local transformer manufacturer and ended up with one which, while having nothing to spare in physical dimensions, was capable of delivering a nominal 250 volts to the filter at about 55 mA.

The usual HT low-frequency filtering is used but the RF filtering consists simply of a 4700 pf miniature capacitor (or .005 mfd standard) in the supply and a .25 mfd in the set.

HT VOLTAGE

With about 5.7 volts at the transformer centre-tap, we measured just on 240 volts at the set at a current drain of the order of 52 mA. with the set tuned to a station.

Discussion on the low tension switching and filtering is best covered by tracing the route taken by the low tension wiring. From the accumulator, the unearthed side (be it positive or negative, depending upon the brand of car) enters the

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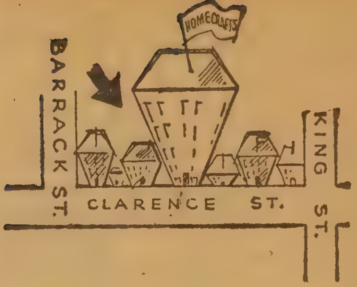
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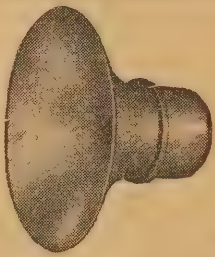

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case, passes through the internal mounting plate of the power supply, is anchored by a tag mounting strip and passes through shielded wire to the switch on the volume control potentiometer (R8 in the circuit).

From the other side of the switch, it is fed to the unearthed side of the heater circuit, to the dial lamp and back through another shielded wire to the power supply. Here it passes through a filter, consisting of a hand-wound low tension RF choke with a .5 mfd capacitor to the common earth point from either side of it, and thence to the centre-tap of the vibrator transformer.

This arrangement differs from the previous Karset designs in that the additional RF filtering provided within the set as a precaution against ignition interference served only in this case to introduce vibrator "hash" into the wiring of the set. It was virtually impossible to mount the choke in any position on the small chassis in such a way that this condition could be avoided.

LITTLE OPTION

Mounting the filter within the power supply could overcome this objection but by reason of it then being in the interference field of the vibrator, it would probably increase the "hash" currents on the incoming 6 volt lead in the set.

In the circumstances, we had little option but to leave it out and expect that treatment of ignition interference external to the set would prove sufficient.

The treatment within the set was simply one of running all 6 volt leads in shielded wire, bypassing the on/off switch on the volume control to the chassis and selection of a common earth point on the chassis for the bond with the power supply and the earthing of one side of the heater circuit. This means that all valve heater wiring is shielded, both negative and positive.

All interconnecting leads between the two units are shielded, except the HT lead. This can be shielded if you wish but we found it unnecessary. The shield braid of these wires is tied to the bond point of the partition plate and serves as a heavy bond between the two units.

The construction of the power supply is in line with our usual technique.

All power supply components are mounted on an internal mounting plate on which a suitable point is selected for all earth returns except those of the chassis-mounting 8 mfd electrolytics. We term this a common earth point.

SINGLE POINT BOND

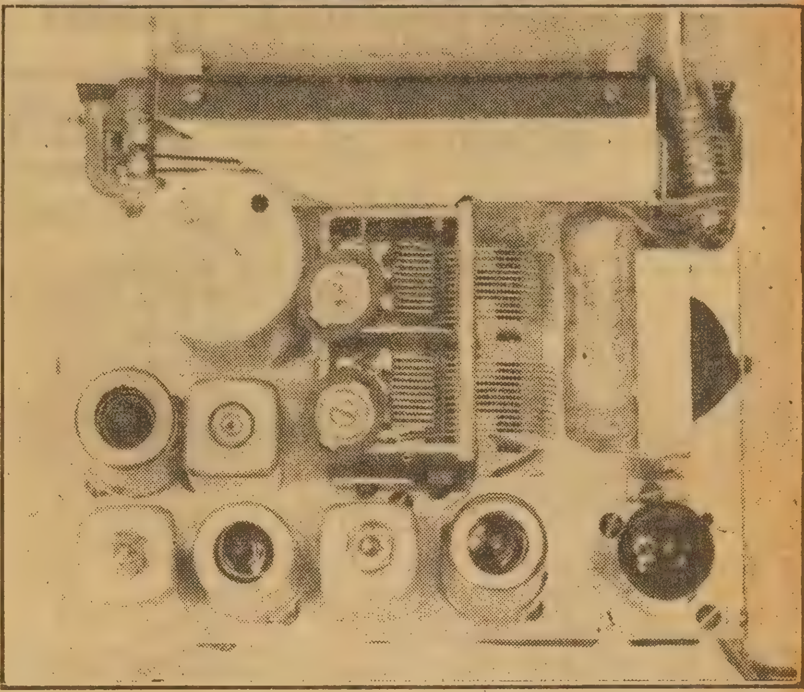
The internal mounting plate is insulated from the partition plate but connected electrically at one point only. As mentioned earlier, this point on the partition plate is bonded to the chassis of the set.

The insulation of the mounting plate by passing the support bolts through rubber-grommeted holes also provides cushioning against mechanical noise from the vibrator cartridge.

In tackling the construction, we suggest that the following approach be taken.

Mount all major components on the chassis including the dial. You will need to make two small brackets to secure the gang to the chassis. Tighten the brackets so that no stress is placed upon the gang frame.

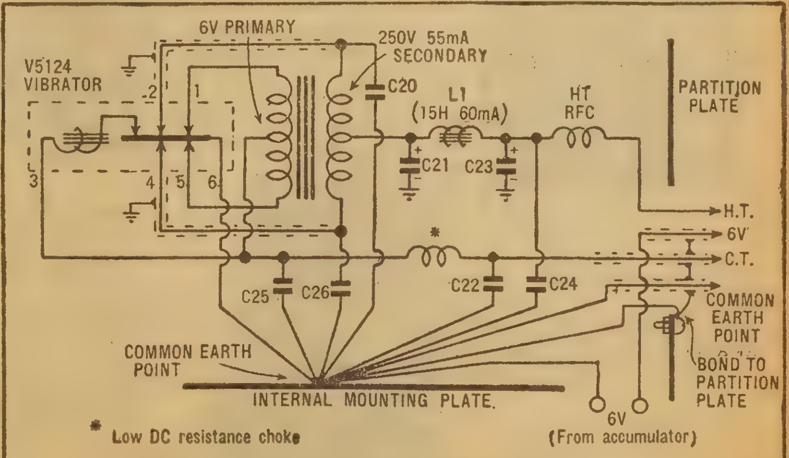
A TOP VIEW OF THE RECEIVER



Looking down on the chassis. The aerial coil is at the top left with the oscillator coil behind it. Components around the edge of the chassis (left to right) are the converter, IFT1, IF amplifier, IFT2, audio amplifier, output valve and output transformer. Note the position of C19, bypassing the 6-volt line. Trimmers C3 and C6 are on top of the gang.

Three brackets are required for securing the dial. The two small ones at the bottom are clearly seen in the underchassis photograph to attach to the drive cord roller support bolts. The upper bracket is arranged to carry the dial lamp socket. See that all bracket bolts through the gang frame do not foul the gang rotor or stator plates. Before the dial is slipped into position, release the drive drum from the dial backing plate and slip it on to the gang spindle.

For ease of wiring and a logical lay-out of minor components, it is important that the coils, IF transformers and valve sockets be suitably orientated. We suggest the following arrangement: — The aerial and oscillator coils with the grid pin nearest the gang, the IFT1 with the B-plus connection toward the rear corner, IFT2 the same as IFT1, the 6BE6 socket with the gap between pins 1 and 7 toward the aerial coil, the 6BA6 socket with the gap toward IFT1, the 6AV6 socket with the gap toward the 6BV7 socket and the 6BV7 with the gap between pins 1 and 9



The circuit of the vibrator power supply. Note that all earth returns should be made to one point on the plate, which is then bonded to the partition. Slip spaghetti tubing over the HT secondary leads before the shield braid goes on to minimise possibility of short-circuits.

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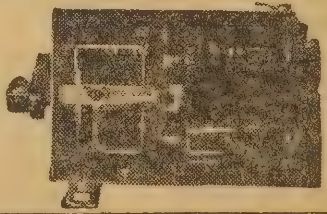

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39/6 Postage: NSW., 5/-; Interstate, 7/6 toward the adjacent side of the chassis.

Place a solder lug under the gang front bracket bolt, each lug of the aerial can, and under both nuts of all valve sockets and the speaker socket. Use a lock or star washer with all bolts, under the head in some cases and the nut in others.

This method of positive connection with the chassis may be a suitable alternative to tying all solder lugs together with a run of light gauge tinned copper wire to avoid faulty earth connections under some lugs, either initially or in the future. Use both methods if you wish, but, on all accounts, avoid for yourself the worry and exasperation which can be associated with an intermittent earth contact in the wiring to the chassis.

TAG STRIP

The only tag mounting strip is a 3-tag size secured under the gang rear bracket bolt. The bolts which hold the aerial socket are used also to secure the small ignition filter coil in the aerial input and to support a ½in threaded insulating pillar. A solder lug at the top of this pillar acts as a tie-point for the junction of R1, R2 and C9.

Go around all valve sockets, earthing the centre spigot and pins shown on the diagram as being earthed. Lay in simple wiring runs between major components and valve sockets, including the shielded heater circuit. Earth the shield braid at a number of points.

At this stage, there is a clear run to lay in the minor components. We suggest that you use the positions indicated in the underchassis coded photograph as a matter of convenience. There is however, one important point here. Place the two resistors, R3 and R4, right at the socket of the 6AV6. The other ends should be cut reasonably short and extended with hook-up wire, taking care to slip insulated sleeving over the join. The extended end is then connected to its appropriate part of the preceding circuit. If this positioning of these resistors is not observed, you run a grave risk of introducing instability in the IF stage.

The junction of the two resistors and the capacitor in the grid circuit of the 6BV7 is a self-supporting connection. The cathode resistor of this valve is laid in the chassis bend.

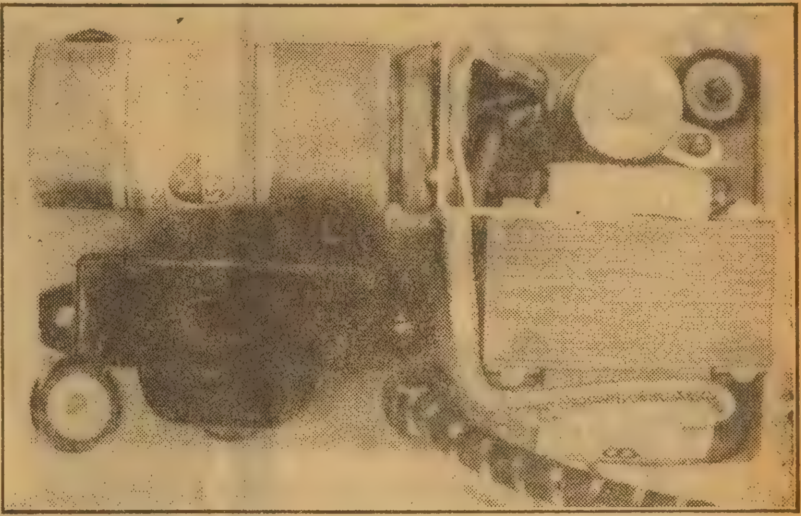
The leads to the moving arm and the "hot" side of the volume control should be made in the shielded wire. We returned the "earthy" end of the control to an earth point near the 6AV6 socket through unshielded hook-up wire.

MINIATURE COMPONENTS

As indicated in the parts list and the underchassis photograph, all minor components are of the smallest size obtainable consistent with the electrical requirements. You will need to use these types in most cases as there just isn't enough room for the larger ones.

The common earth point for the heater circuit and the interconnection of the set with the supply is at the corner near the 6BV7 socket. Slip some insulated sleeving over the shield braid of these leads to avoid shorting to the wiring of the set when the units are pushed into the case. Do not earth any capacitors to the shield braid of the incoming and outgoing 6-volt leads.

THE VIBRATOR POWER SUPPLY



A plan view of the top of the vibrator unit, showing the transformer (lower right) with the 8 mfd. electrolytic above it. The H.T. filter choke is at the lower left, with the vibrator on its side. After completion, the power cord should be tied to the lower left corner mounting bolt, to keep it clear of the transformer windings.

Minor components on top of the chassis are C19 and the two gang section trimming capacitors. When fitting these trimmers, keep them below the maximum height level and see that the top plate is the one which connects to the gang frame.

The construction of the power supply is fairly straightforward. Two important points are that the leads from the transformer secondary to the vibrator socket be in shielded wire and that the vibrator cartridge should be mounted so that the gap between the internal contacts is in the vertical plane when the set is mounted in the car.

The "lay" of the gap of the vibrator contacts is given by an imaginary line through the centre of the cartridge and the soldered lug on the outside of the can. We found that this line coincided with the line through pins 3 and 6 of the V5124 cartridge used. Assuming that the set will be mounted in the car in the normal position, this imaginary line should be parallel with the internal mounting plate. By the way, you will need to trim the length of a couple of the socket lugs to avoid fouling the transformer winding.

The transformer buffer capacitors, C20 and 626, are tucked away under the vibrator socket and earth to a lug under the head of a bolt holding the transformer and to which on the other side of the plate the common earth point is made by securing three solder lugs under the nut and fanned out.

On the underside of the plate, there is plenty of room for the components. With the chassis-mounting 8 mfd bend one lug parallel with the can and cut the other one off. A 3-tag and a 5-tag mounting strip are used to anchor the connections between the wiring and the components. The LT RF choke is made up by winding

Underneath the vibrator unit. Note the 8 mfd. electro. and the H.T. honeycomb choke to the right. The hand-wound L.T. choke is near the centre with C22 and C25 to the left. The common earth point is at the nut seen immediately above the L.T. choke.

Building an Amplifier?

then don't start without these SPECIAL VALVES

There's a Philips valve for every socket of every transmitter or receiver. The valves shown on this page are a few from the complete range of Philips valves designed especially for Audio Amplifiers.

PHILIPS EF37A

Pentode Amplifier with low hum and anti-microphonic construction.

Heater: 6.3V. 0.2A.

Plate voltage: 250V. D.C.

Transconductance: 1800 umhos.
Stage gain as resistance-coupled Amplifier: 175.
Base: Octal.

PHILIPS EL34

Output pentode for heavy-duty work: 10-100 watts.

Heater: 6.3V. 1.5A.

Power output: 11 watts (single valve) with 250V. plate voltage. 35 watts (two valves) Class AB with 375V. supply. 100 watts (two valves) Class B with 775V. supply.
Triode connected single valve: 6 watts, 375V. supply.
Base: Octal.

PHILIPS 6M5

Output pentode: 5-10 watts.

Heater: 6.3V. 0.71A.

Power output: 4.9 watts (single valve) with 250V. plate voltage. 9.4 watts (two valves) Class AB with 250V. supply.
Base: Noval.

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about 22 turns of something around 16 gauge enamelled wire on a pencil.

The braid on the interconnecting leads should terminate at the hole in the partition plate and care taken to see that it could not be pushed back into the hole and short to any internal connections in the supply.

The cable to the accumulator should be tied to a corner of the mounting plate to keep it well away from the power transformer in its run out of the case. Although no fuse is shown in the circuit diagram, it is a simple matter to fit a cable-type fuse holder if you wish.

Use cable or leads of a size sufficient to avoid undesirable voltage drop. Similarly, in the 6-volt run to the set and back to the supply, it may be necessary to parallel two leads for each run to avoid voltage drop. It's easy to lose .2 to .3 of a volt here.

At this stage, switch the set on and with the aid of a voltmeter check the polarity of the high tension. If it is negative with respect to the chassis of the set, reverse the connections to the vibrator socket of either the primary or secondary winding of the transformer, whichever is easier.

Attach a short length of aerial and proceed to align the circuits. There will probably be some indication of vibrator "hash" interference but don't worry about it until the set is properly fitted into its case.

CIRCUIT ALIGNMENT

If you have no alignment oscillator, tune in and identify a station toward the high frequency end of the dial. Adjust the oscillator trimmer until the station tunes at about its correct spot on the dial in terms of frequency and "peak" the aerial trimmer for loudest volume.

Tune in and identify a station around the 600 kc mark and adjust the oscillator coil slug until it is tuned at its correct spot on the dial. Adjust the slug in the aerial coil for loudest volume. Now tune in any station and adjust the slugs in the top and bottom of the IF transformer cans for loudest volume. Repeat the alignment procedure.

You will need to make final adjustments to the aerial coil slug and aerial trimmer when the set is coupled to the car aerial through its associated length of cable.

To fit the set together, line the nside of the partition plate with thin cardboard and space it away from the mounting plate on the 1¼in bolts just sufficient to clear the underneath components. Cut off excess bolt length. Drill holes in the case and partition plate fold so that t can be secured in position with self-tapping screws.

Make a light cardboard shroud for the power supply sides so that when t is slipped into the case, there is no likelihood of the internal mounting plate of the components mounted thereon touching the sides of the case. Complete the shroud with a ining in the rear cover. The front and rear covers are secured with self-tapping screws.

If you have rigidly adhered to the layout of components as shown and o the constructional advice given, we expect that you will have little rouble with vibrator "hash" interference. The question of the elimination of ignition interference is another story and in some cases calls or individual treatment. Some helpful advice on this matter was given n the April, 1952 issue under the heading "Installing Your Karset."

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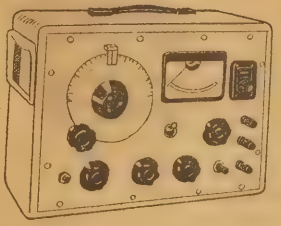

AUDIO TESTER Type TF 894

Tests on all types of audio equipment are simplified by this instrument, which provides a stable beat-frequency oscillator, with accurate output attenuation and an audio voltmeter in the one unit. Frequency range — 50 c/s to 12 kc. Output — 300 mW max., into 600 ohms ladder attenuator. 0 to 50 db, or 5000 ohms direct, continuously variable. Audio Voltmeter — 0-10, 0-20, 0-40, 0-80 Volts r.m.s.

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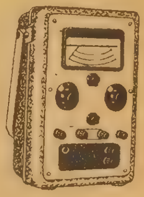

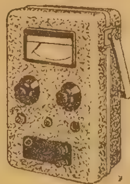

VALVE MILLIVOLTMETER Type TF 899

Measurement of small or a-f voltages is enabled by this instrument. A jack is provided for earphones so that the meter may be used as a signal tracer, without disturbing the circuits under test unduly. Another common use is the determination of gramophone pick-up characteristics. Ranges—0 to 150 mV, 500mV, 2 V. Frequency response—50 c/s to 50 Mc plus-minus, 1 db, 50 c/s to 100 Mc plus-minus 2 db.

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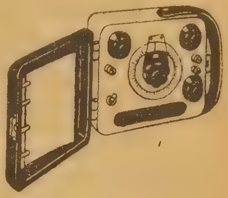
A very compact portable frequency meter, designed both for setting up the frequency of transmitters and for checking the calibration of receivers. The fundamental bands are 100-200 kc and 1000-2000 kc/s, but a continuous cover of 100 kc to about 25 Mc may be secured by the use of harmonics.



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Here's your answer, Tom!

Tom is having transformer trouble this month. Without a meter and with no identification for the various wires the best transformer may just as well be a chunk of iron and copper for all the use it is. We've given Tom a few practical hints about identifying the windings and he should be able to sort things out.

BY the way, we've noticed that some transformer manufacturers are a little careless in coding their products. It does make it hard for the beginner, but a little commonsense will, in most cases, overcome the difficulty.

We will let Tom tell his own story.

I have been trying to puzzle out the connections to a power transformer and have got them all sorted except for four black leads, all marked 6.3. Can I use any pair of these leads and must one side of the winding be connected to earth?

Fair go, Tom. Let's have the questions one at a time.

In the first place, you can't just use any two of the leads to supply the valves.

The four leads, you see, belong to two separate windings, each one rated to deliver 6.3 volts and each one capable of supplying probably two or three amps without overheating. The manufacturer could just as well have used a single 5 or 6 amp winding except that the heavier wire required for such a winding might be harder to handle.

Don't hold the wires together . . .

To identify the leads, the proper way is to check them with an ohmmeter, selecting the leads which belong to the one winding. If no meters are available, you can wait until the transformer is mounted in place on the chassis. Connect up all the leads you know, instal the power flex and add the plug. Keeping the unknown wires clear of one another, and keeping clear yourself of the rectifier and mains wiring, plug in to the power point and switch on.

WATCH FOR SPARK

Brush any two of the 6.3 volt wires lightly together until you find two which spark. This will be one pair. The remaining two wires will be the other pair.

But, for heaven's sake, Tom, don't hold the wires together permanently or you'll overheat the transformer and burn it out. And the smell of smoke from a burning transformer is most unpleasant!

As for the earthing business, heater windings aren't always earthed in the same way. Generally speaking, heater windings supplying valves other than the rectifier should have some connection to earth, or should we say to the chassis.

The most usual arrangement, as employed in ordinary receivers, is to earth one side of the winding. In the case of amplifiers where hum problems might arise, the winding is frequently earthed via an actual centre-tap or by means of a centre-tapped resistor. In a few cases the earthing may involve a return through a bias circuit.

Until you know the score better, Tom, we suggest you follow the original circuit, rather than try to exercise your initiative.

The heater supply to directly heated rectifiers like the 5Y3 and the 80 is never earthed because it is virtually the take-off point for the H.T. supply. An earth link here would mean a direct short circuit.

Can a magic eye be used in any set, and, if so, should it always close on a station? If it doesn't close, would there be something wrong with the set?

You're quite a genius on the double and triple-barrelled questions, Tom.

In the first place, a magic eye is only likely to serve a useful purpose on sets which are equipped with automatic volume control. The shadow angle then automatically follows the tuning and shows when the set is adjusted correctly.

WITH NO AVC . . . .

With a set not fitted with AVC it would be difficult to make the eye work at all. But, even assuming that it was made to work, the shadow angle would merely vary in obvious fashion as the signal, in equally obvious fashion, became more or less loud.

The degree of closure depends both on the strength of the incoming signal and the design of the receiver. On a weak station, or when using a poor aerial, the receiver may not be fed with sufficient signal to close the eye. Therefore, the eye cannot rightly be expected to close under all circumstances. For the same reason, the failure of an eye to close does not indicate any fault in the receiver.

The best that can be said is that a highly sensitive receiver, properly adjusted, will generally produce a better tuning indication than one which is less sensitive or misaligned.

Your question reminds us of the story about the maiden lady who complained to the serviceman that the eye winked at her. But, of course, that's another story.

I have often heard that a transformer breaks down an electric current, but I have also heard nearly the same thing about a resistor. Although I know that the contents are different, I cannot understand the difference in the functions. Could you please explain this clearly?

Since you ask so politely, Tom, it would be a pleasure.

First of all, you seem to be in a bit of a tangle about the word current. In electrical language, current is the word used to indicate the volume of electricity flowing. You should have used the word voltage in your question because you were really trying to express the idea of electrical pressure.

The higher the pressure the better it is able to overcome any resistance which may be placed in its path. Therefore, for a given conductor a high voltage will cause greater current to flow than a low voltage.

I insist. It winked at me!

Alternatively, if you have a fixed voltage, greater current will flow if you connect a low resistance conductor than will flow if you connect a high resistance conductor.

From this you will see that voltage, current and resistance are very closely connected. In a particular circuit you cannot vary one without varying one of the others.

Having briefly straightened out your ideas about voltage, current and resistance, we can go on to explain how a resistance can be used to reduce an electrical potential in practice.

Say, for example, you have a 6V battery and a 6V torch globe. Connect the globe to the battery, one lead to the positive terminal and one lead to the negative terminal and the globe will light brightly. That's all very well for ordinary easy-going every-day sort of people, but you may be one of these difficult types who insist on being different.

You may not wish to have the lamp at full brilliance, or you may desire that less, than the full amount of current be drawn from the battery.

A RESISTOR

If so, you can wire a resistor (a device which resists the flow of electric current) in the circuit. Simply lift one of the leads from the battery and wire one terminal of the resistor to the open terminal of the lamp and the other terminal of the resistor to the battery. In completing its circuit the current must flow through the resistor so that for a given voltage the magnitude of the current will be less.

The voltage will be divided between the lamp and the resistor, and, of course, less than the full 6V will appear across the lamp. By adjusting the value of the resistor you can adjust the voltage appearing across the lamp to any value you like between 0 and 6V.

One more point. The way the voltage divides itself between the lamp and the resistor depends as much on the resistance of the lamp as it does on the resistance of the resistor. Therefore, if you install a lamp of different resistance, but still wish to have the same voltage appearing across it, the value of the dropping resistor will have to be changed.

To complete the story. Metals such as copper and silver have a very low resistance and are most valuable for making connections between components where it is desired to lose as little power as possible. Where it is deliberately desired to introduce extra resistance, carbon, nichrome and other materials are frequently used. The physical form of resistors varies widely according to their use. You will soon get used to the different types.

A transformer, on the other hand, consists essentially of two coils of wire, close together and wound around the same iron core. If alternating current be applied to one of the windings a similar alternating current will appear at the other.

Understand, Tom, that a transformer will not work when a steady direct current is applied. It would take too long to explain why, so we will leave that until another time.

TURNS RATIO

If the two coils have the same number of turns, the voltage appearing across the second winding is the same as that delivered to the first winding by the power mains. However, if you put a fewer number of turns on the secondary, the voltage appearing across it will be lower.

By the same principle, you can have a greater number of turns on the secondary than on the primary, and the voltage developed across it will be higher than the mains voltage.

Depending on the ratio of the number of turns on the secondary to the number of turns on the primary practically any voltage can be generated in the secondary. This is the main reason for using alternating current in power distribution systems. High voltages are used for distributing power over long distances so that it does not matter too much if there is some resistance in the power lines.

Unlike resistors, a theoretically perfect power transformer does not absorb power in itself. It merely changes the ratio of the voltage and current. In practice you can expect a transformer to dissipate a small amount of power due to the resistance of the windings and other factors. But if the transformer engineer has done his job properly it won't be much.

I recently noticed in a shop some rather attractive switches marked "For battery sets only." Why the distinction? Couldn't a switch be used for anything because after all, a switch is just a switch?

That's perfectly true, Tom. "A switch is just a switch." But, by the same reasoning, a motor lorry is just a motor lorry and one could presumably dump four or five tons of pig-iron on to the tray of some wheezy old truck and expect it to move without the slightest protest.

Or one might buy a big diesel truck and use it as a laundry waggon.

The point is, Tom, that switches have their ratings and design factors, just like any other device. But let's stop talking in riddles and give you the facts.

One might ask three pertinent questions about any given switch. The first: How much current will the contacts carry and break without deterioration?

SOME FACTS

The vital point is that the flow of current through any circuit or device is accompanied by the generation of some heat. The higher the current the greater the amount of heat generated.

In a switch, the current generally has to flow through connectors which make contact with the external wires. There are usually two or three riveted joints, sundry leads and a couple of pieces of springy metal which form the contacts.

If the current is too high for the size of these bits and pieces, or if they aren't properly surfaced to prevent corrosion, the inside of the switch will start to heat up. This leads to more corrosion, more heating and so on until the contacts fail by loss of tension, &c.

A second question might be: What degree of insulation is there between the contacts?

The point is this, Tom. If you only want a switch to control a torch globe or a car tail-lamp, you needn't worry too much about insulation. Almost anything will do to mount the contacts, from pressed cardboard to the cheapest bakelite.

There is little danger of the few volts present causing leakage across the insulation and ultimate breakdown.

When it comes to breaking a circuit operating at a much higher voltage, say 240 volts, the insulation must be of high quality and un-

(Continued on Page 91)

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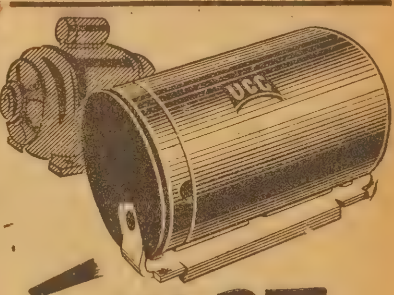

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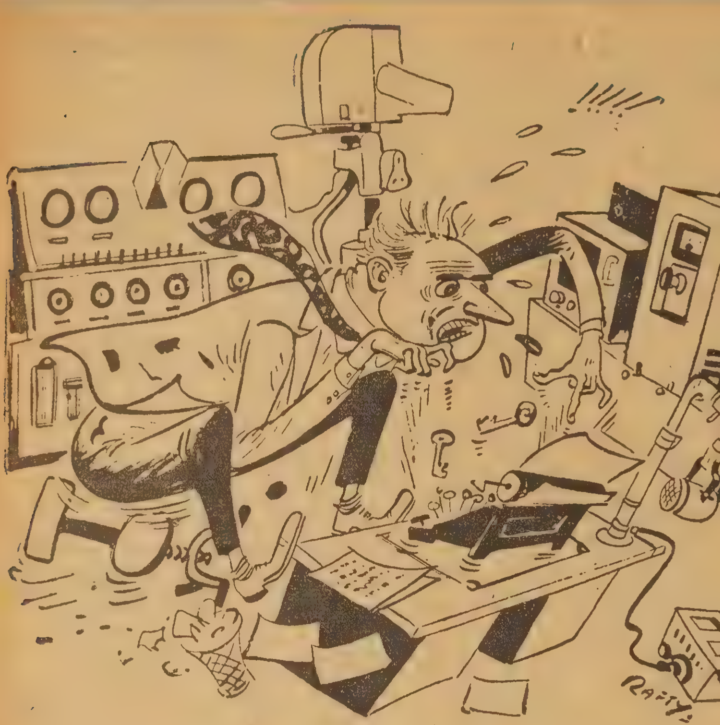


Let's Buy An Argument

Though I tried, in a nice kind of way, to round off the subject of tape recording—at least for the time being—it rates another mention. I can foresee the Editor groaning inwardly "not tape again" but we'll have to risk that.

by W. N. Williams

THE reason for my saying anything further is that I was queried during the month regarding my assertions about gap alignment. Without trying to quote exact phrases, the general theme of the objection ran something like this: "Your remarks about gap alignment aren't really justified in practice. There might be errors in the cheap machines, but they don't matter anyhow. In the professional field, equipment's too frequently checked for errors to reach significant proportions."

Oh, brother!

Just in case there are others who think likewise, it might be interesting to relate the circumstances which caused me to make the remark in the first instance. You are at liberty to draw your own conclusions.

As you will doubtless realise, a great many of the programs we hear over the air these days are recorded in sundry studios and the tapes are passed hither and thither for broadcasting. Most common standard in the commercial field is 7½in/sec full-track.

Now it so happened that I got hold of one of these tapes and, as a matter of interest, tried to play it on my own humble tape deck. To my horror, it was so distorted as to be almost unlistenable.

Not just unbalanced, mind you, but poor level with sheer, rank distortion!

After a certain amount of deliberation and messing about, I loosened the playback head and tilted it this way and that. In one position, the level came up sharply and the distortion completely disappeared.

As I indicated last month, this new position involved locking the head in place with a 1/8in washer under one edge.

I was disappointed, but not altogether surprised, that my poor, unpretentious little head should be so far out of line. The tape, I felt sure, could never be suspect.

However, to verify the point, I pulled enough strings next day to land a tape which was an original recording from an American network station. On my poor, humble, unpretentious deck it sounded just terrible—until I removed the washer which was holding up one side of the head!

With the head sitting flat and square on the deck it was first rate.

THIS WAY AND THAT

Well, I tilted the head back and forth, I checked the tape run with the deck surface, I checked the contact area with the head. I tried a pressure pad, but there was only one answer . . . my poor, humble, unpretentious head was dead in line with the American tape and hopelessly out of line with the local one.

They couldn't both be right.

Next day, I took both tapes along to an engineer friend who has a big American recorder of a type seldom seen in this country. The result was very definite—his head, my head and the American tape were all in line; the other one was the "odd man out."

This hardly looked like a coincidence, but I sought and found a third tape which had originated from another local studio—one of the commercial stations.

It played quite well on my own deck and might have passed as normal. However, a very slight tilt in the direction required by the first mentioned tape made a noticeable difference to the extreme treble, even on speech sibilants. We now had three "standards."

Just to cap it all, a few days ago another friend bought a professional recorder which was supposed to be properly adjusted and all ready to go. At my suggestion, however, he cross-checked it with an overseas tape that he happened to have on hand.

I don't know what the degree of error was, but it "sounded rather deep," according to his report. After going back for adjustment to the head, it sounded "ever so much better."

Now I'm not so naive as to believe that the same remarks would apply to all the tape machines which are currently in use, but my little story does seem to indicate quite definitely that significant discrepancies do exist in this much vaunted professional equipment.

Quite apart from the fact that one expects the highest possible standards in this field, it seems self-evident that full-width heads are much more critical of alignment than the half-track types. Get them a little out of line and the longer gap begins to scan whole slabs of waveform at once.

First the top disappears, then, as the error is increased, the reproduction becomes positively "woolly." After that, the overall level drops and finally the reproduction becomes so hopelessly distorted.

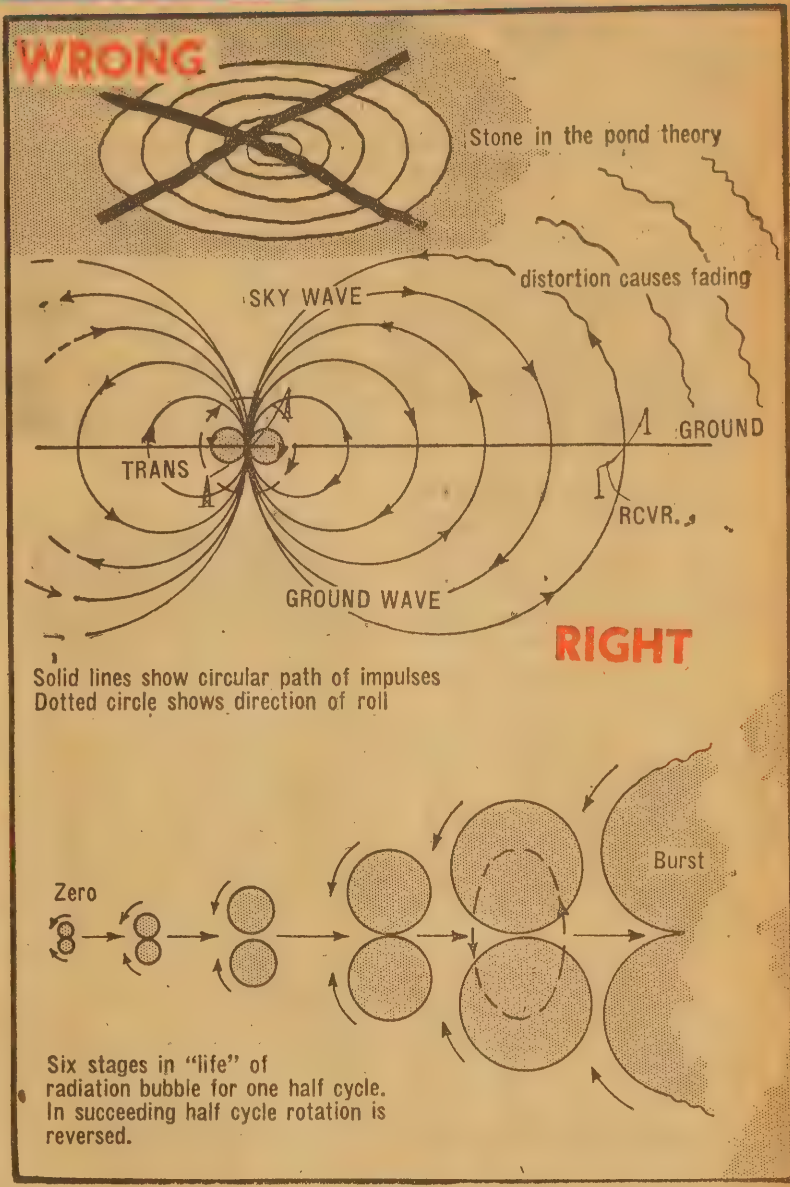
The reason, it appears, lies in the relative scarcity to date of standard 7½in azimuth tapes, which would allow individual engineers to set and seal the heads to a high degree of accuracy.

In the absence of such tapes, they have tended either to take the machines for granted or to strike an average setting for the machines and tapes which come to hand. If such an "average" happens to off the vertical, it is just too bad!

The production people go ahead and "can" large numbers of programs which must subsequently be played back on the misaligned head if the original quality is to be preserved. Any suggestion from a well-meaning engineer that alignment be subsequently corrected is likely to start a civil war.

(Continued in column 3.)

YOU CAN WORK THIS ONE OUT!



Solid lines show circular path of impulses
Dotted circle shows direction of roll

Six stages in "life" of radiation bubble for one half cycle. In succeeding half cycle rotation is reversed.

Dear Sir,

My friend and I are involved in a fierce argument concerning the nature of radio transmission waves. My friend has been trained in a radio college and is an expert serviceman. I am a book learner. We are both agreed that the transmitter and receiver are operated by alternating current.

My point is this, that every impulse that leaves the transmitter also returns to the transmitter along a circular path. My friend showed me the stone in the pond theory. He insists that the sky wave and the ground wave both travel in the same direction. I say they move in opposite ways. They must do otherwise you can't get an alternating current.

A radio impulse is in fact an expanding magnetic bubble rotating at great speed. When the impulse loses its momentum the bubble bursts.

Obviously the frequency determines the wavelength. The alternations are determined by the rotation of the magnetic bubble. I have enclosed a sketch to demonstrate my point. If you cannot follow my reasoning, roll a tennis ball around a pencil. Or imagine a worm-wheel rotating on the axis of the worm. Think of the worm as the aerial, power applied to the worm as the current and the worm-wheel as the magnetic bubble.

I would like your opinion on this very interesting subject.

It is easy to understand why ultra short-range V.H.F. has a limited range. The impulse is so rapid that the power is not enough to expand the magnetic bubble to any great size. If more power was applied the frequency might overlap and create a longer wavelength or bad distortion in the case of amplitude modulation. This would not happen with frequency modulation because every impulse is the same strength.

I have a good reason to think that television could be transmitted on medium and long waves. In fact the longer the wave the better the results. There is a catch. Great power would be required. The low frequency would only be used for frame and line control. The picture impulses would be transmitted by making the magnetic bubble vibrate at 5 or 6 M.C. or whatever the case may be. You could call it velocity modulation on long waves. Well, what do you reckon?

Yours sincerely,
J.R. (Geelong, Vic.).

(Continued from column 1.)

So the error is perpetuated until somebody outside begins to complain that such-and-such an organisation's tapes are distorted.

My experience may have been unfortunate, of course, but, if not, it indicates the urgent need for more accurate work with standard tapes.

Otherwise, I can foresee tape being branded unjustly as "the easy way you can't rely on."

While picking on broadcasting and studio people generally, I might as well air another grievance—one concerning microphones.

Times out of number I have heard studio types stating their preference for various microphones and, in so doing, attributing to them mysterious and decidedly untechnical qualities. The terminology is strangely akin to that used by record enthusiasts to describe their favorite pickups.

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In the latter case it might be excusable, but recording engineers and panel operators should be able to manage better in the exchange of ideas.

Only yesterday a visitor from interstate expressed marked preference to me for a certain cardioid microphone over ribbons, crystals, condensers or anything else.

"It isn't that the others are not flat, but the cardioid just brings the voice to life."

OTHER IDEAS

Another participant in the same discussion suggested that "a good crystal was satisfactory for music—flat from 40 to 10,000 you know—but they're harsh on speech."

You'll find others ready to sneer at any local microphone, "even though it might be flat and all that."

I've heard it said that some microphones are more sensitive to distant sounds than others, amplifiers not withstanding.

Says someone else . . . "the best test for any microphone is to jingle a ring of keys and listen to the result."

Gentlemen, please!

I remember the first time we tried a certain moving coil pickup in our laboratory. It sounded most impressive, particularly in the way it could pick out triangles and other little edgy and tinkling sounds in the orchestra.

No other pickup we'd ever heard sounded quite like it.

We were to learn later that the pickup had a marked resonance at about 8 Kc and, when this was tuned out, the triangles retreated to their rather unobtrusive place in the scheme of things.

In some respects, bunches of keys are very like triangles!

Now don't get me wrong. I'm not suggesting that there aren't notable differences between microphones or that the "bunch of keys test" is meaningless.

WHAT IS THE REASON?

What I am suggesting is that mysterious qualities like "presence," "liveness," "body," "harshness" and so on exist because of—not in spite of—the ordinary electrical characteristics known as response, distortion and pattern.

If a microphone is "crisp" or "harsh," you can start speculating in terms of peaks and distortion, maker's claims notwithstanding.

If it is "heavy" or "thin," you can bet your last dollar on a rising or a falling bass response.

If it has specially good "presence," you might look for maximum response in the 2000 to 3000 cycle region with a taper both ways.

A mic. might be "hollow," simply because it has a figure-of-8 pattern that catches an echo from way back in the studio.

And, of course, microphones change their behavior according to their distance from the source of sound.

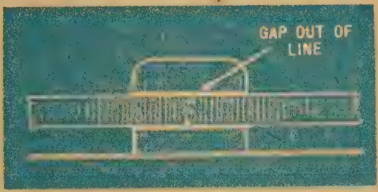
Close up on speech, the majority of ribbons, for example, sound "heavy" or "chesty." Yet their response may be exactly right for a more distant piano or organ — or anything else!

I had a candid type mic. once which was superb on close-up speech and singing. Yet, in a church it didn't even "hear" the big pipes of the organ. Something to do with the pressure or velocity response of the diaphragm, the makers said.

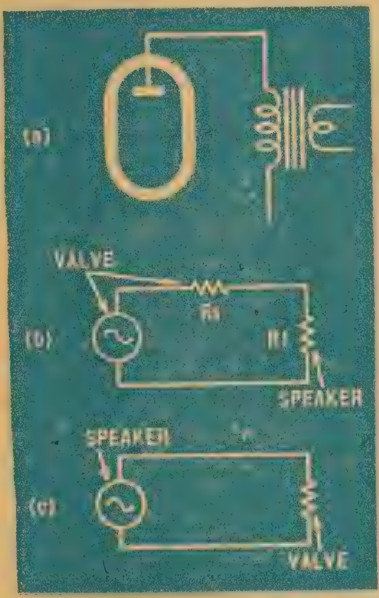
To all this the retort might be . . . "What's new about that?"

Well nothing, except the plea that we correlate the factors covering microphone performance and attempt to exchange our ideas in tangible electrical terms rather than abstractoddities. (One word. Pat. Pend.)

* * *



It is suggested that misalignment, affecting both response and distortion, are more common in the commercial field than is generally supposed. Fact or fancy?



The actual circuit (a) is often reduced to the equivalent form (b) but it only tells part of the story. As far as cone damping is concerned, circuit (c) is nearer the mark.

But enough of that. Having posed a few questions last month about the behavior of amplifiers with low or negative output impedance, I guess it's up to me now to answer them. You can accept my explanations or argue — whichever you please.

Without such arguments, this column would die an ignominious death.

You'll remember that I referred to the usually accepted equivalent circuit for an audio amplifier, consisting of an AC generator feeding a load through a series resistor (figure 2b), the latter representing the amplifier's own internal impedance.

I asked a few "teaser" questions about the behavior of zero or negative impedance amplifiers — whether they would burn out a link shorting their output terminals. If not, why not? And how can you have an electrical generator with negative internal resistance?

Well then. Let me begin by suggesting that the usual equivalent circuit, handy though it might be for the average case, is more likely to be a hindrance than a help when you start getting into "special" amplifiers. Of course, that's a matter of opinion.

But let's start at the beginning and see how far we get.

We attribute the property of low output impedance to an amplifier if it exhibits two main characteristics:

(1) The output voltage (neglecting deliberate compensation) does not vary abruptly with reactive changes in the value of output load.

(2) It tends to damp electrically — and efficiently — any tendency of the loudspeaker cone to "freewheel" or oscillate of its own accord, after the driving signal has ceased.

I realise that the key terms in the above are comparative but I think you'll know what I mean.

TWO APPROACHES

Now the effect of low output impedance is commonly achieved in practice either by using a triode output stage or a pentode stage with negative voltage feedback.

A triode achieves requirements (1) by virtue of the fact that it has a naturally low output impedance. It does, in fact, conform closely to the traditional equivalent circuit. (Fig. 2b.)

A pentode, on the other hand, has a naturally high output impedance which allows the output voltage to vary widely with changes in load resistance.

However, the voltage feedback, as conventionally applied, resembles a fast-acting AVC system which operates to keep the voltage gain of the output stage more nearly constant, irrespective of load variations.

Thus, if we can do a little mental gymnastics, we might suggest that negative feedback does not really reduce the output impedance of a pentode stage. Rather, by satisfying requirement (1) with an "AVC" effect, it only appears to have done so.

(Perhaps that's why the application of feedback to an output pentode does not affect its optimum load requirement.)

BACK-TO-FRONT

However, to get back to the point, since feedback has the same effect on output voltage regulation as does a reduced plate resistance, it is mathematically convenient to continue the illusion. We therefore use equivalent circuits and formulas which attribute an ohmmic value to what we have just described as "an AVC effect."

The whole situation rather reminds one of the convention of quoting valve noise figures as an equivalent resistance — a transparent but convenient bit of mathematical fiction.

But what about requirement (2), the ability of an output stage to damp electrically free oscillations of the speaker cone?

Before you can go another single step, it must be realised that this

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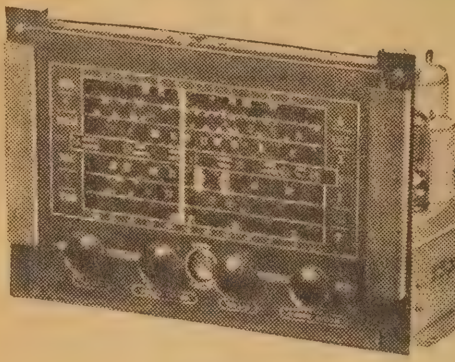

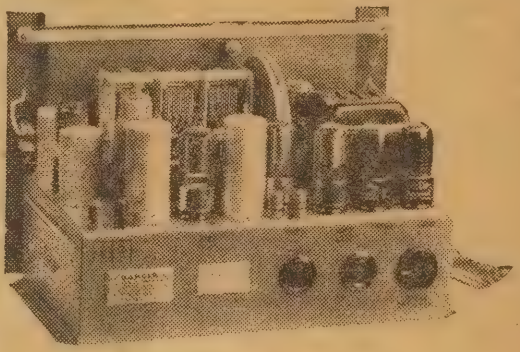

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involves turning the conventional equivalent circuit back-to-front (figure 2c).

When the speaker is oscillating on its own account, it becomes the generator and the output valve becomes the load.

In actual fact, this interchange of functions is simultaneous and continuous.

If, in the middle of a tense scene, the villain fires a shot, the speaker cone is pushed violently this way and that and thereafter has to oscillate back into its central position. Meanwhile, the lady of the piece is screaming her head off.

Thus, while the output valve is pumping "scream" frequencies into the speaker, the latter is pumping low frequency energy (due to cone oscillation) back into the valve. And this sort of thing goes on all the time, as part and parcel of the damping action.

"RESISTIVE" DAMPING

To the speaker, oscillating on its own account, the output plate circuit looks just like a resistor of some specific value. The speaker, in its temporary role as a generator, cannot place potential across the said plate circuit without there being a resultant flow of current.

Multiply voltage by current and you have the amount of power dissipated in the damping circuit. In the ultimate, this amounts to an expenditure of mechanical energy and explains why an electrically damped cone comes to rest more quickly than one which isn't so damped.

In the case of a triode, the damping effect is naturally quite severe. Let's say we have a 2A3 under standard class A conditions and assume that the speaker tries to feed a 50 peak volt pulse back into the plate circuit. With an effective plate resistance of 800 ohms, this will produce a peak current of 62.5 mA. and involve a peak power of 3.1 watts.

This has to come from the speaker, not the output valve.

If you work out the same figure for say a 6V6, you will find that a 50-volt plate swing produces only a 1-milliamp current swing and involves 50 milliwatts of power.

The natural damping is thus very poor.

But when you apply feedback to such a stage, a positive-going swing reaching the plate from the speaker reacts immediately in the grid circuit and produces a positive pulse of plate current which tends to pull the output voltage down.

ACTIVE OPPOSITION

In other words, the stage as a whole actively opposes the voltage generated by the speaker rather than simply absorbing the energy by simple dissipation.

However, be that as it may, a pentode stage with feedback satisfies our original requirement number (2) and the picture is complete. As before it is convenient to compute the property in ohms, as if it were ordinary plate resistance.

Now there's another point. How can you have potentials developed across a generator, which, by reason of feedback, has an output impedance equal to zero or even equivalent to a negative quantity? (This question has been posed in my hearing several times.)

The answer, I think, follows logically from what I have already said. The output impedance, as such, is never zero or negative or anything like it. Really speaking, it has remained unaltered.

Rather, by the use of special feedback arrangements, we have merely achieved a degree of regulation and a damping factor which would be equivalent to those in a stage having zero or negative output impedance characteristics.

FAR ENOUGH!

Our bit of mathematical fiction has been pushed to its limit.

Well, then, would a zero impedance amplifier handling a signal, burn out a shorting link across its terminals? The answer is no, because, no matter how you fiddle with the circuitry, no output valve can possibly produce infinite current.

After all, valves are only human!

The moment the output of an amplifier is shorted, the output voltage disappears. There can then be no voltage feedback and therefore no artificial lowering of output impedance due to feedback.

In other words, the amplifier would revert to the characteristics of any other amplifier, without feedback, having a short across its output. The current through the shorting link is simply determined by the natural characteristics of the output valves, the transformer and its ratio and the general circuit voltages.

And here's just a final "thought for today." In considering plate resistance, particularly in respect to loudspeaker damping, it is essential to remember the two modes by which the plate current and voltage can be affected.

Looking back at the plate from the speaker end, quite a large amount of energy is required to swing the plate voltage. From the grid end, it is just too easy.

In the specific case we worked out for the 2A3, a 50-volt peak from the speaker end involved a total "drive" of 3.1 watts.

From the signal end, it involves only 15 volts across a 0.5 meg. load, representing a drive power of less than one tenth of a milliwatt, or something of that order.

You can duplicate or accentuate this ratio as you please with feedback on any output valve. I just mention the point in case it helps you with your thinking.

THAT LETTER

While in a thinking mood have a look at the letter and the diagram on page 37. Apparently, in this business of arguing, I've a mate down in Geelong. He doesn't mind in the least picking on a lot of textbooks and accepted ideas.

Perhaps he's the herald of a revolution in theory. Or perhaps he's just a "bloke" with the wrong idea.

But why should I answer all the arguments? You can do the condoning or condemning for a change. Who's right? J. R. or his pal, the expert serviceman?

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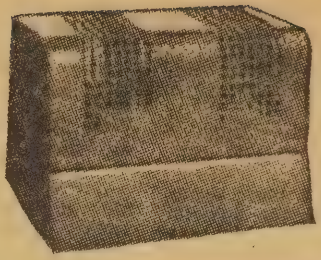

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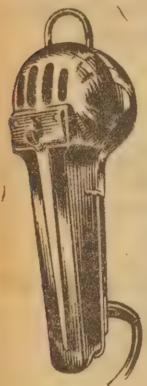

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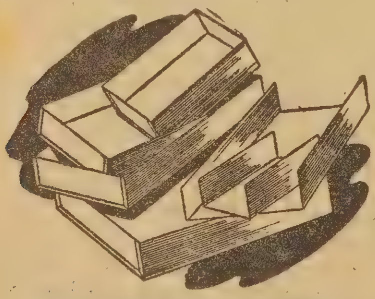

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A COURSE IN TELEVISION

PART 47 — HIGH GAIN ALL-CHANNEL AERIAL

The whole problem of television aerial design was discussed at length in the March and April issues, last year. As a sequel to these articles, a recent issue of the "Aerovox Research Worker" carries details of a most interesting multi-band aerial which illustrates modern design trends.

IT must be stressed, of course, at the outset, that this type of aerial may never be required in Australia, because the number of stations in operation will probably be fewer and they will in any case probably occupy adjacent channels.

At the same time, the design is of considerable technical interest and may be applicable in amateur stations to cover the 50 and 144 Mc bands.

The present VHF television frequency allocations in the US, which provide for 13 channels in two widely separated bands, makes the design of a single antenna for all-channel operation a difficult engineering problem.

WHAT IS REQUIRED

The requirements of broad-band operation, together with high gain, are seemingly contradictory and are difficult to attain in practice. In addition, a satisfactory design must exhibit the following characteristics:

(1) A reasonably constant feeding impedance over both VHF bands.

(2) Sufficient mechanical strength to withstand heavy wind-loading, ice-loading, and in some localities bird-loading.

(3) Sufficient front-to-back discrimination to reduce "ghost" picture reception.

(4) A neat, unspectacular rooftop appearance.

(5) A low angle of reception.

(6) Ease and economy of fabrication.

The complete fulfilment of these requirements is seldom, if ever, encountered in any single design, and most commercial TV antennas presently available are compromises between the various factors enumerated above. The antenna to be described here is a particularly satisfactory solution to such compromise design problems.

Its physical appearance is as shown in Fig. 1.

STATIONS GROUPED?

In the design of a fringe area television antenna it can usually be assumed that all of the transmitting stations to be received are grouped in a distant metropolitan area so that a single broad-band array with fixed orientation may be used.

In areas where weak signals are received at azimuthal angles greater than the width of the pattern of the antenna being used, mechanical rotation of the array is usually best. This solution has more "landlord appeal" than the use of separate arrays for each channel to be received.

The operation of a single dipole antenna over either the entire low band (54-88 Mc) or the high band (174-216 Mc) is not too difficult if the dipole is made of larger diameter conductor or is of the folded dipole type.

Length-to-diameter ratios of 200:1 or less in a simple dipole result in Q values sufficiently low to permit efficient operation over such ranges.

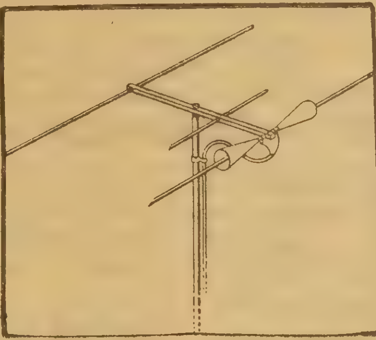

Figure 1: The complete high-gain all-channel television antenna.

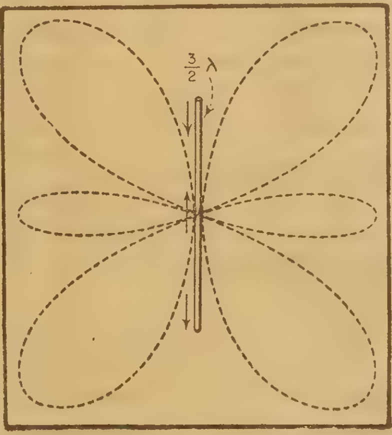

Figure 2: Showing the "split" radiation pattern of an antenna three half-waves long.

The usual practice is to cut the dipole to resonate near the low frequency end of the band to be covered. It is then inductive at the adjacent higher frequencies but functions efficiently since the reactance does not vary as rapidly on the inductive side of resonance as it does on the capacitive side. A more uniform response versus frequency characteristic is thus obtained over a limited range.

A simple dipole cannot be used effectively in fringe areas to receive all of the presently assigned VHF channels, however. This limitation arises since a 4:1 frequency ratio exists between the extremities of these two television bands.

HARMONIC OPERATION

If a dipole is one half-wavelength long in the lower portion of the low band it will be between three and four half-wavelengths long at the high channels. Such "harmonic" operation of an antenna results in "splitting" of the simple figure-eight dipoles pattern into multiple lobes. The number of lobes will be equal to twice the number of half-wavelengths in the radiator.

Fig. 2 illustrates the radiation pattern of a straight-conductor antenna which is three half-wavelengths long. The complex pattern is caused by the out-of-phase currents indicated by arrows in Fig. 2.

Such a pattern is highly undesir-

> THE Television Course has now been running for just on four years, and readers who have followed it from the inception should by now have a useful background of knowledge. The course is now virtually complete and future articles in the series will cover special aspects of the subject and will be presented from time to time as the occasion arises.—Ed.

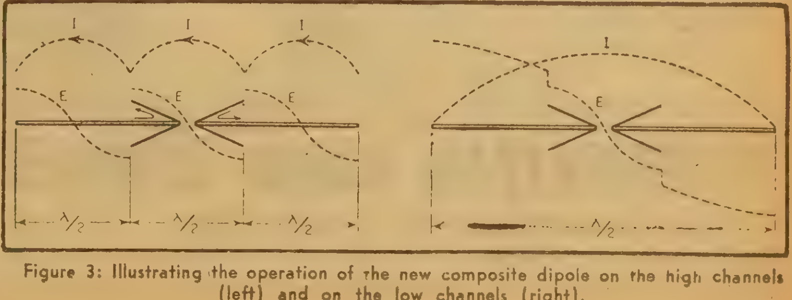

Figure 3: Illustrating the operation of the new composite dipole on the high channels (left) and on the low channels (right).

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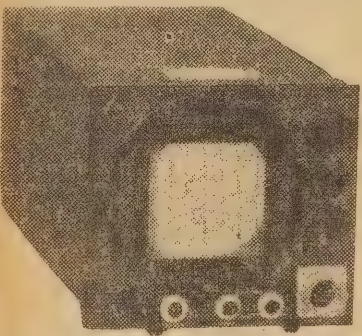

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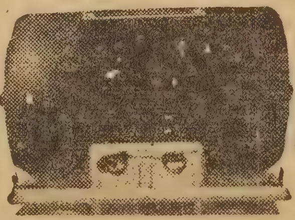

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able, especially at the high-band frequencies, since the response is considerably reduced in the direction perpendicular to the axis of the antenna and the large side lobes make the antenna susceptible to multi-path reception, ie, "ghosts."

The dipole thus has very poor high-band response in the direction which it favors when used for the low channels.

The remedy which has been widely used in commercial designs to prevent lobe-splitting on the high bands involves bending the arms of the dipole forward to form an obtuse-angle "V." This modification of the dipole tends to superimpose the lobes of the otherwise split pattern (Fig. 2) and thus maintain response in the desired direction.

IN-PHASE RADIATION

Another method of maintaining a uniform dipole pattern has been suggested. This arrangement incorporates phase-reversing sections in such a manner that the dipole functions as three collinear half-waves in phase on the high band, while performing as a single half-wave element on the low channels.

It will be recalled that if the alternate half-wave sections of a long wire antenna are folded into quarter-wave phasing stubs to prevent radiation from them the currents in the radiating sections are in-phase and their radiations add in the plane normal to the axis of the wire.

The resulting collinear antenna, having three dipoles in-phase, has a gain of almost 3db (power gain of 2) compared with a single resonant dipole on the high bands.

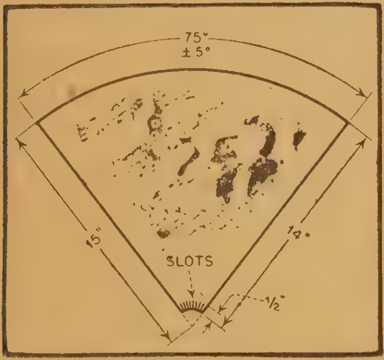


Figure 5: Dimensions of the sheet stock for the phasing cones.

In the present design, phase reversal is accomplished by two conical sleeves mounted coaxially with the low-band dipole and with "A" pieces connected to it at the feed-point.

These sleeves are one quarter-wavelength long at the high band mid-frequency. The outside surfaces act as part of the radiating system of the antenna while the inside surfaces function as folded coaxial phasing-sections.

Fig. 3 shows the current and voltage standing-wave distributions on the combination dipole for both the low and high VHF channels. The conical phasing sections do not appreciably affect the performance of the dipole on the low band.

The dipole thus modified gives a uniform bi-directional pattern over both bands to be covered.

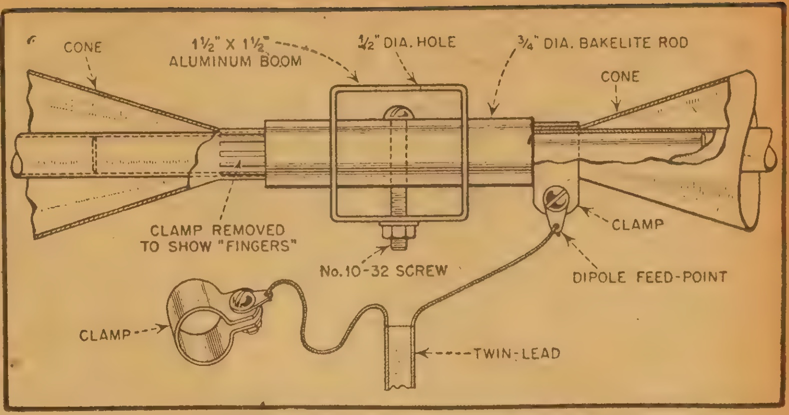


Figure 6: Assembly details of the centre insulator and mounting.

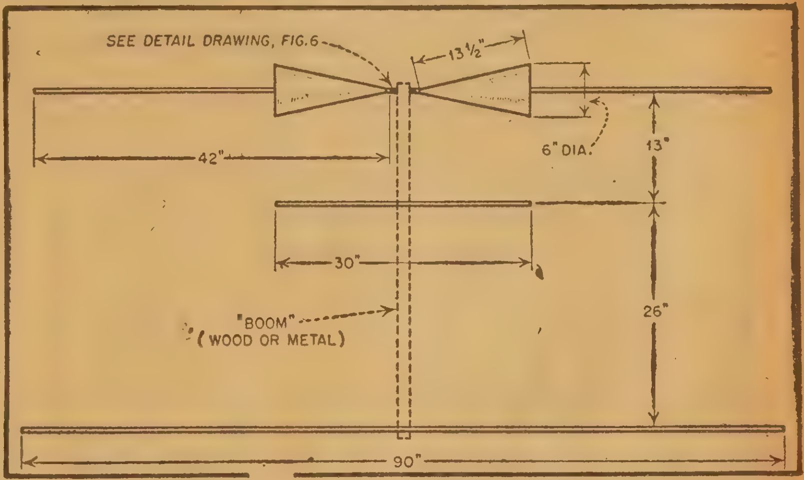


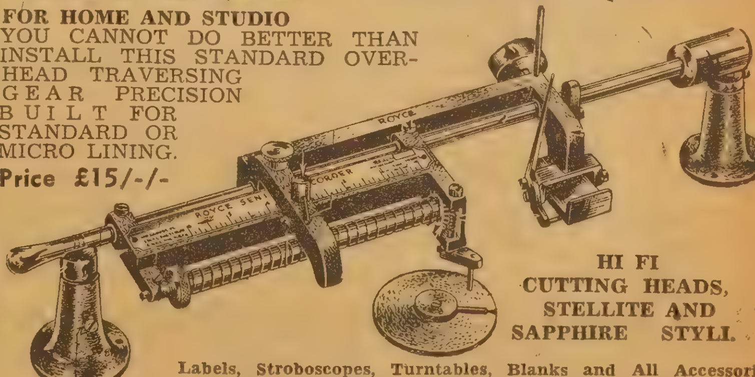
Figure 4: Overall physical dimensions of the aerial. Proportionate adjustment would have to be made to operate on other frequencies.

To reduce "ghost" reception and co-channel interference from the rear, however, a unidirectional pattern is highly desirable. Such directional characteristics, as well as additional gain, may be achieved by the judicious use of parasitic reflectors.

Most designs use wide spaced reflectors to avoid excessive reduction of the radiation resistance of the driven element and narrowing of the operating bandwidth. A reflector spacing of one quarter-wavelength at the low band is usually chosen. A reflector thus spaced also acts as a reflector on the high channels, since its spacing is approximately three quarter-wavelengths at these frequencies.

Its effectiveness is considerably reduced, however, and at frequencies where the spacing approaches one full wavelength the pattern becomes bi-directional. For this reason separate reflectors are used in the present design for each band of television frequencies.

The physical dimensions of the antenna are shown in Fig. 4. The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1332-9H	200-220-230-240	300	120	2 x 6.3v-2A; 5v-3A	53/3
1356-3H	200-220-230-240	400	150	5v-3A; 2.5v-5A; 6.3v-4A	70/-
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967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
1011-1A	30	15	250	160	1000	59/6
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893-23	5000, 7000	2, 3.7, 8, 12.5	1	*40-15,000	5	SINGLE 6V6G, 6AQ5 ETC, TO VC	28/3
894-23	500	2, 3.7, 8, 12.5	2	50-10,000	5	LINE TO VOICE COIL	26/3
900-22	2500, 5000	2, 3.7, 8, 12.5; 15	1	*40-15,000	15	SINGLE 807, EL34 ETC, TO VC	57/6
896-9	8000, 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR AB1 TO VC	62/6
897-9	8000, 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP 6V6G's A OR AB1 TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR AB1 TO VC	62/6
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL	42/6
870-26	10,000	2 or 8	1	*20-20,000	6**	PP 6V6G's OR 807's AS TRIODES	57/6
871-9	10,000	2 or 8	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
872-9	10,000	3.7 or 15	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
891-22	6600	83, 100, 125, 166, 250, 500	1	50-12,000	35	PP 807's AB1 TO LINE	82/6
892-22	3200	50, 62, 83, 125, 250, 500	1	50-12,000	55	PP 807's AB2 TO LINE	97/-

INPUT TO GRID TRANSFORMERS

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519-6	20,000 TO 80,000 OHMS	SE OR PP	RADIOMETAL CORE	1:2 RATIO 30-10,000 CPS	69/-
620-6	20,000 TO 180,000 OHMS	SINGLE ENDED	RADIOMETAL CORE	1:3 RATIO 30-10,000 CPS	69/-

DRIVER TRANSFORMERS

545-9	SE 4000 TO PP AB2 GRIDS 1.6:1 PRIM. TO ½ SEC. RATIO 50-10,000 CPS 5 WATTS	57/6
588-6	SE OR PP 5000 TO PP 807's CLASS B. 200-5000 CPS 5 WATTS	52/6

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705-6	PP 30,000-600 OHMS	RADIOMETAL CORE MAX LEVEL 250 MW 30-10,000CPS	69/-
712-6	PP 30,000-200 OHMS	RADIOMETAL CORE MAX. LEVEL 250 MW 30-10,000CPS	69/-
710-6	SE OR PP 20,000-600 OHMS	RADIOMETAL CORE MAX LEVEL 250 MW 30-10,000CPS	69/-
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★ **A & R FOR QUALITY** ★

reflectors and low-band dipole are constructed of ½-inch aluminium or duralumin (24ST) tubing. The centre boom can be made of wood, although 1½-inch square aluminium tubing (61S) is preferable.

The cones are constructed of thin copper or aluminium sheet stock or may be made of copper screen. If the latter construction is used a ½-inch wide strip of sheet copper should be formed into a 6-inch ring and soldered to the inside surface of the cone at the large end to add mechanical support.

With some grades of screening, it may also be necessary to reinforce the cones by soldering several similar narrow copper strips along the sides. The cones should make electrical contact with the low-band dipole only at the apexes. Fig. 5 gives the dimensions of the sheet-stock from which the cones are formed.

If aluminium is used, rivets must be employed to join the seams. Copper, of course, may be soldered. For a small fee the services of a tin shop may be engaged to form the cones.

CENTRE CLAMPING

Electrical contact is made between the small end of the cones and the low-band dipole by cutting "fingers" in the former, which fit around the dipole and are tightened by a strip-metal clamp. Two 8-32 screws are used to tighten the clamps and also provide convenient terminals for the attachment of the 300 ohm transmission line.

The centre spacer of the dipole assembly is made of ¾-inch round bakelite rod about one foot long. This rod is turned down to the inside diameter of the dipole tubing for a distance of 4½ inches from either end.

The centre portion of the bakelite rod fits through a ¾-inch hole in the boom and is securied by a 10-32 screw.

The ends of the low-band dipole tubing are slotted with a "hacksaw" to a depth of ¾-inch so that the clamps which tighten the fingers of the phase-reversing cones also secure the low-band dipole to the bakelite centre-insulator. Fig. 6 illustrates the details of this mounting.

The high and low-band reflectors are secured to the boom in a manner similar to that employed for the driven element. The boom is drilled to receive the ½-inch tubing, which is held in place by 10-32 screws through the tubing and one wall of the boom. (Assuming square aluminium tubing is used.) The opposite wall of the boom is drilled with a ½-inch hole to facilitate introducing the screws.

Although complete gain and pattern data are not as yet available on this antenna design, field testing in weak-signal areas have proven it capable of consistent all-channel reception in localities as remote as 85 miles from the transmitters.

"STACKED" DIPOLES

For improved gain, two such antennas may be "stacked" one above the other at a distance of one-half wavelength at the low band (about 90 inches).

Feeding is accomplished by joining the two feed-points with a straight, un-transposed length of 300 ohm transmission line and connecting the 300 ohm receiver feed-line to the centre of this length.

In connecting such broad-band systems to the television receiver, some compromises are usually necessary, and perfect impedance matching is not always possible.

Impedance miss-matches between the antenna and the transmission lines are not nearly as serious as a miss-match between the feed-line and the receiver. In the latter case, high standing-wave ratios are set up on the line, resulting in greater losses in the dielectric and by radiation.

A miss-match between receiving antenna and line, on the other hand, effects only the efficiency of power transfer. Therefore, more care is usually taken to achieve a good match at the receiver end and accep any necessary compromise at the antenna end.

In the case of radio transmissio systems this situation is reversed.

In erecting the television antenna height is of extreme importance Also a location as remote as possible sought, since automobile ignition noise is a prime source of TV interference.

The antenna should be tried in several locations on the roof while the results are monitored on the TV set. If interfering "ghosts" are present, a location change of only a small fraction of a wavelength will frequently cause great improvement.

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BATTERY POWERED AMPLIFIER

An amplifier operated entirely from batteries, but capable of fidelity and power output normally associated with mains operated amplifiers, is the subject of this article. As there is more to it than simply building the amplifier in this case we have spent some time discussing the associated problems. This is the first of several designs which will bring high quality to the man away from the AC lines.

by Maurice Findlay

IF you are a record enthusiast and lucky enough to live at the end of a 240-volt line, you can take your pick from dozens of excellent amplifier designs. The initial cost of the components may be high in some cases but you are never likely to have to worry about running costs.

The country man, who lives well away from the mains power, has quite a different problem to face if he wishes to have satisfactory record production. Not only must he consider the initial cost, but running and maintenance costs must be carefully worked out. It isn't any use having an amplifier which will turn out 20 watts of the highest quality audio if you are afraid to use it because of the expense.

We have discussed this same problem in Radio and Hobbies on several occasions previously. The November, 1942, issue carried the description of an amplifier operating from a 2-volt accumulator and a 135-volt block of B batteries. It used a 1K5-G pentode as a voltage amplifier and a pair of 1L5-G's is push pull in the output stage which was capable of delivering something in the order of 1 watt.

For plenty of readers this power would be sufficient. Feedback was applied to the amplifier and, if on odd occasions the output happened to reach overload point, the result would not sound too unpleasant. From our point of view, at the present time, the greatest disadvantage is the rather involved battery arrangements. Including the C battery for biasing purposes, a total of 6 batteries is required.

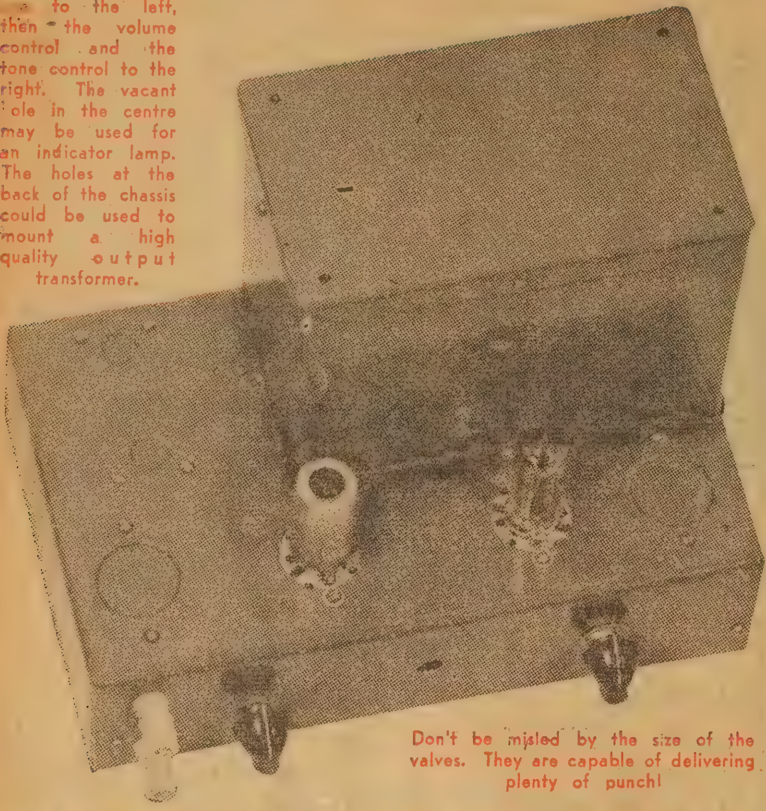
The three 45-volt B batteries are simply disregarded when exhausted, while the A battery will withstand many rechargings over a period of years, provided it is properly looked after.

Some technical knowledge on the part of the operator is required because, when the amplifier refuses to deliver the full output it has to be decided whether the 2V accumulator or the 135-volt supply is to blame. In practice this frequently results in some wastage. Amplifier enthusiasts these days look for a less messy solution to the power supply problem.

DRY BATTERIES

The trend with country radio receivers is to favor the miniature 1.4-volt series, 1R5, 1T4, 3V4, &c. The receiver then operates entirely from a block of dry batteries. The ratio of the capacity of the A batteries to that of the B batteries can be so adjusted that they reach their end of life point at about the same time.

An amplifier using a single 3V4 in the output could be expected to deliver about ¼ watt. This could be increased to ½ watt by using a pair of them in push pull. Possibly even this amount of power would be enough for some of our readers. An efficient speaker and a quiet location can make a very big difference to the amount of electrical power required for effective listening.



[illegible] terminals [illegible] to the left, then the volume control and the tone control to the right. The vacant hole in the centre may be used for an indicator lamp. The holes at the back of the chassis could be used to mount a high quality output transformer.

Don't be misled by the size of the valves. They are capable of delivering plenty of punch!

Readers who are impressed by this approach to the problem could use the audio end of one of our 1.4-volt receivers or possibly we will go into the matter in Radio and Hobbies at a later date.

Then, in the May, 1949, issue, we described an amplifier powered entirely by a single 6-volt accumulator. A vibrator unit was used to convert the 6-volt supply to the 180 odd volts required by the plates of the output valve. A 1K5-G was used as a voltage amplifier followed by a 1L5-G driving a 1J6-G operating under class B conditions.

The power delivered to the speaker was of the order of 2 watts, while the total current drawn from the 6-volt supply was only 1½ amps. Again, there will be many for whom this type of amplifier will be an excellent solution to the problem of record reproduction.

Its disadvantages are chiefly concerned with quality. Feedback cannot be applied in the straightforward manner customary with class A and class AB1 resistance coupled amplifiers and you are completely at the mercy of the manufacturer of the driver transformer.

Amplifier enthusiasts nowadays are used to talking in terms of amplifiers that aren't very far from perfect. If we are to hold our heads up in this community during the year 1953, a new battery amplifier must conform to current standards.

In order to get more power and better quality we are forced to go to amplifiers using indirectly heated valves and a high tension supply with the same voltage and current capabilities as a normal AC operated amplifier.

The filaments will normally be operated in a simple parallel circuit from a 6-volt accumulator or in a series-parallel network from a 12, 24 or 32-volt supply. For the high tension supply either a vibrator unit or a genemotor is normally used.

Incidentally, the excellent 24 and 28-volt genemotors which are available from disposals dealers are a very satisfactory solution to high tension problems for radio and amplifier enthusiasts who have 32-volt home lighting plants. They are available at a small fraction of their original cost and in a wide variety of current and voltage capabilities. A heavy duty low value dropping resistor can be wired in series with the primary leads where necessary.

> The amplifier proper uses the latest miniature valve types but is basically the same as any AC operated amplifier designed to do the same job. The vibrator power supply is a good deal simpler than is required for a receiver because the filtering requirements are not so critical.

If you can put up with the battery drain, there is no reason why you cannot copy any one of our standard high powered AC amplifier designs. Genemotors caused very little trouble with interference, so that a minimum of filtering is required.

However, for standard Radio and Hobbies designs we cannot consider anything other than components which can be bought over the counter from any one of the normal radio parts suppliers. In this way genemotors are prohibitively expensive and a vibrator supply becomes a far more practical proposition.

AC VALVES

We have already described a number of amplifiers using indirectly heated valves and vibratory high tension supplies. They range from the 4.5 watt "Vibravox" amplifier of the September, 1946, issue, to 15 watt "6-240" amplifier described in the February and March, 1949, issues.

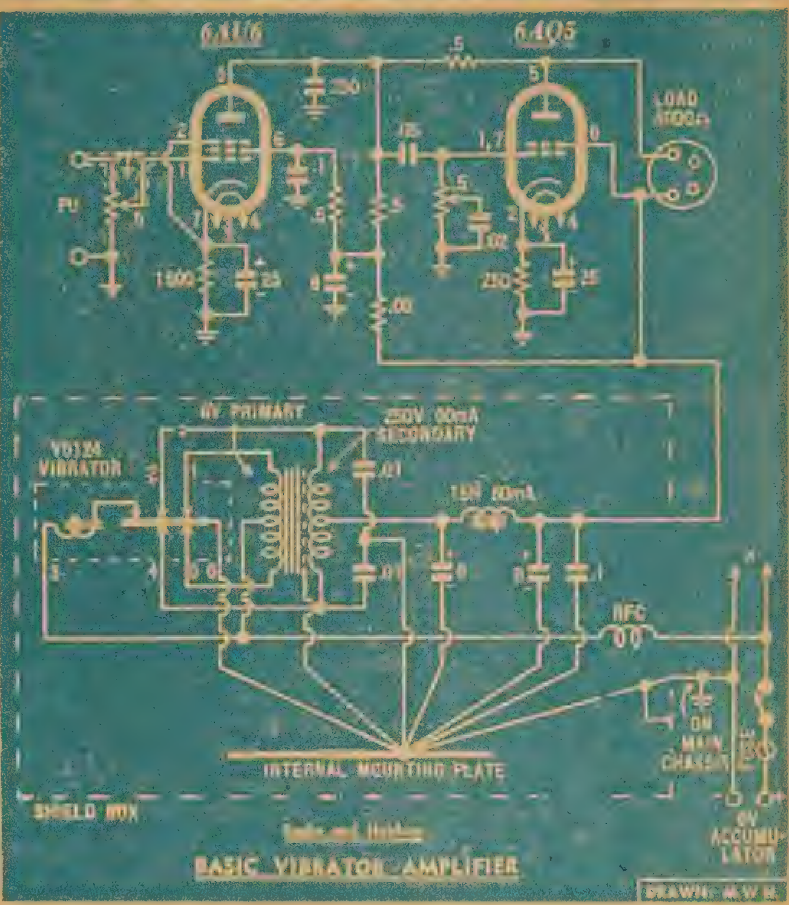
These and other similar designs have always been popular with readers, whether for purposes of home entertainment in places remote from power mains or mobile public address. The latter involves a basic amplifier and power supply plus a low level preamplifier for a microphone. We will have more to say about the subject in a later article.

Our main interest at the moment is to consider the design of an amplifier to provide good quality reproduction of records.

A single beam tetrode of the type 6AQ5, 6BW6 or 6V6-GT will deliver 4.5 watts of audio under the standard 250-volt conditions. By means of a generous application of feedback, the frequency response and distortion characteristics of such an amplifier can be made very good indeed. Plenty of record enthusiasts with access to the 240-volt mains are more than satisfied with such an amplifier.

But what of the same amplifier adapted for battery operation?

SCHEMATIC CIRCUIT DIAGRAM



PARTS LIST

- 1 chassis 9½in x 6in x 2½in.
- 1 shield box 6in x 5in x 3½in.
- 1 mounting plate 5¾in x 3¼in.
- 1 vibrator transformer 6V to 250V at 60 mA.
- 1 filter choke 15H at 60 mA.
- 1 V5124 vibrator.
- 1 6AQ5 valve.
- 1 6AU6 valve.
- 2 7-pin miniature valve sockets, one with shield.
- 1 6-pin valve socket with mounting flange.
- 1 miniature plug and socket.
- 2 spring loaded terminals.

CONDENSERS

- 2 25 mfd 40V electro.
- 3 8 mfd 525V electro (2 with mounting feet).
- 2 .1 mfd 400V paper.
- 1 .05 mfd 400V paper.
- 1 .02 mfd 200V paper.
- 2 .01 mfd 600V paper.
- 1 250 pf mica
- 1 low tension switch.
- 1 fuse holder.

RESISTORS

- 2 .5 meg potentiometers.
- 3 .5 meg 1 watt.
- 1 .05 meg 1 watt.
- 1 1500 ohm 1 watt.
- 1 250 ohm 1 watt or 3 watt preferred.

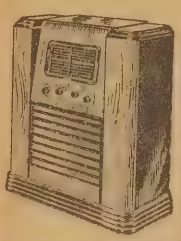
SUNDRIES

Hook-up wire, shielded wire, tinned copper wire, 18 B and S enam. wire, nuts and bolts (4 bolts 2in long), tag strips, 2 knobs, rubber grommets, solder lugs, low tension cable (plastic flex), etc.

The RFC is wound with 18 B and S wire on 3-8 diam to a length of 1½in.

Homecrafts PTY. LTD.

PRICES SLASHED RADIO ★ BARGAINS ★



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Terms £6 dep. 9/- weekly. In Vic only.

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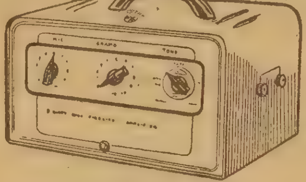

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Made by Pye of England.

7½ watts, undistorted output, 230 volt, A.C. operated; 3 channel input: mike, pick-up and radio; inverse feedback and tone control. Output impedance: 500, 6, 1.25 and 2.5 ohms. Radio 0.37 volt. Valves: two 6AU6, one 807, one 5V4 Terms available in Vic, only; 6 Gns. dep., 50/- monthly.

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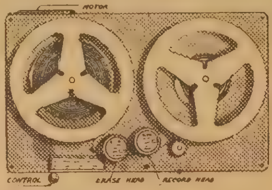

- ★ Weight 7½lbs.
- ★ High fidelity 50 cps to 9000 cps.
- ★ One hour playing for each spool.
- ★ Self-contained motor.
- ★ Electronic Erase head fitted.
- ★ Built in Vernier control.
- ★ Fast forward and rewind.

Price—complete £40

Plus 12½% Sales Tax.

BARGAIN

Electric Gramo Unit

"COLLARO" MODEL 504 GRAMO UNIT

78 R.P.M. Turntable with high fidelity magnetic head. Synchronous motor and automatic stop Brand new, complete.

Cut to only £3/19/6

STOP PRESS BARGAINS

- ★ Amplifier cabinets complete with chassis 39/6
- ★ 5 Valve Steel chassis 1/-
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- ★ 12 volt 500 watt Generator. Originally cost £50 cut to only £4/19/6.
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- ★ Bradley 10,000 ohm Midget Potentiometer 1/6
- ★ Two Gang Tuning Condensers 6/11
- ★ 30 Henry 100 Ma. Power Chokes 12/11.
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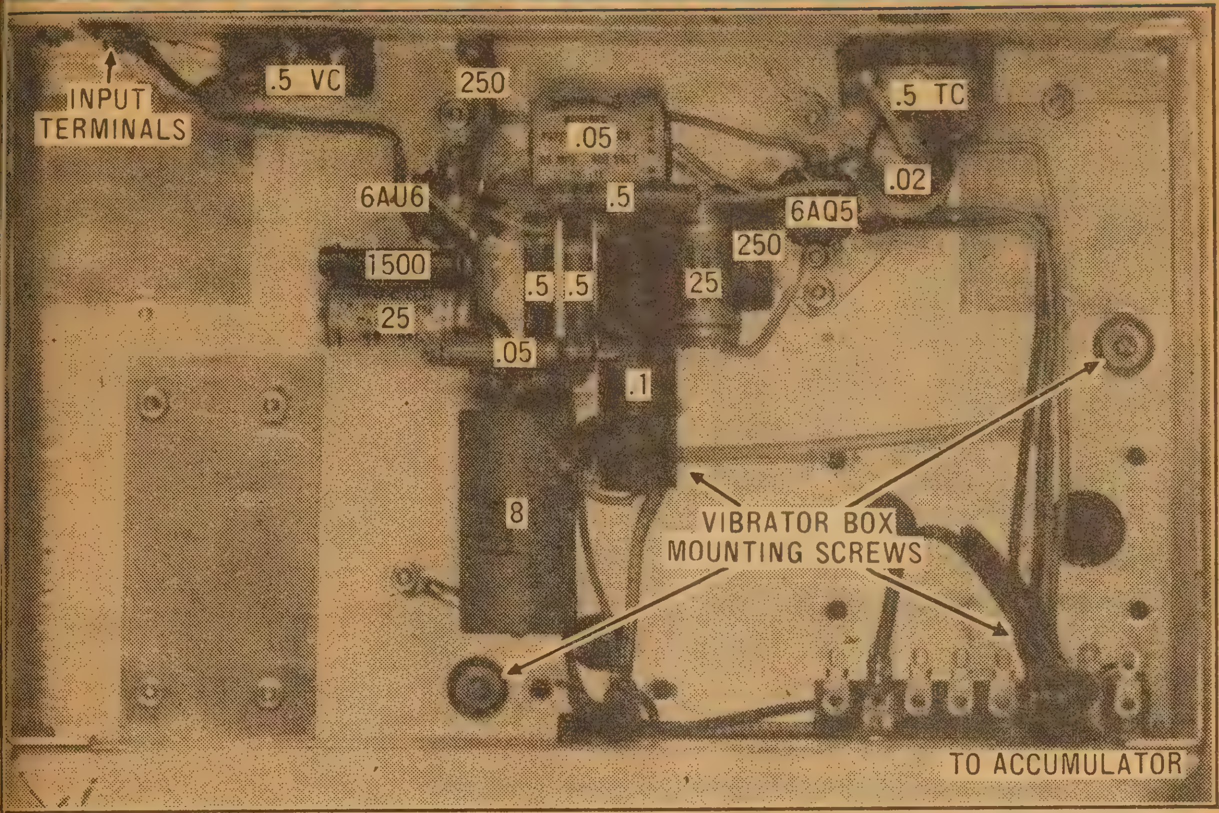
- ★ Half Megohm Potentiometers with D.P. Switch 6/11
- ★ Mica Condenser Bargains. 0001, 00015, 0003, 0004, 0005, 3/9 doz. 001, 002, 003, 0034, 0004, 005, 006, 008, 6/- doz. 01, Mica condensers 1/3 each.

290 LONSDALE STREET, MELBOURNE Central 4311

PHOTOGRAPH SHOWS ALL PARTS IN POSITION



This photograph is almost as valuable as a wiring diagram in that it identifies all components and shows how the wiring should look when you have finished. It is simpler than for an AC amplifier of similar power because the power supply components are mounted separately.

There is certainly no reason why the quality of the reproduction should not be just as good as with the AC version. Standard vibrators can handle the requirements of a single beam tetrode with ease.

The only remaining question concerns operating costs and convenience in terms of battery drain. The success or otherwise of the whole project depends on whether the battery can be kept charged at sufficient frequency and without too much trouble. It is of such vital importance that we will digress here to consider the different aspects of the subject as they affect the country reader.

CURRENT DRAIN

The battery drain of a 4.5 watt amplifier will inevitably be in the vicinity of 4 amps at 6 volts or about half this figure at 12 volts. If you want the 4.5 watts, no amount of clever circuitry will reduce this figure. The power just has to come from somewhere, and the somewhere must be the battery.

For a start, the output valve requires 0.45 amps at 6 volts and any one of the popular voltage amplifiers 0.3 amps, making a total of 0.75 amps for the filaments.

The high tension requirement, allowing for some form of automatic bias, is about 265 volts at 50 mA which works out at over 13 watts. Expressed in terms of drain at 6 volts this works out at about 2¼ amps. The total is now 3 amps. To this must be added the current required to drive the vibrating reed and the losses in the transformer, the rectifying arrangements and the filter network. It can't be done for much less than 1 amp so that the grand total comes very close to 4 amps.

Now to look at the available batteries and what they can do. Batteries for radio and other relatively slow discharge purposes are generally made with thicker plates than car batteries which are required to deliver extremely high currents for starting. The idea is that although the thick plates are not capable of delivering such extremely high current their life expectation is greater.

Thus the capacity in terms of ampere hours of one manufacturer's 9-plate radio battery is equivalent to that of his 11-plate car battery. In this case the figure is 90 ampere hours from a fully-charged terminal voltage of about 6.3 to a completely discharged terminal voltage of 5.5. This means about 22 hours of record playing — provided it is all done within a reasonably short time of the initial charge.

We add the proviso for the very important reason that a fully-charged accumulator does not remain fully charged for very long if simply left standing. This is due to the normal internal losses.

In the case of a fully-charged battery in good condition the specific gravity of the electrolyte will be 1.260. (It varies slightly with different brands.) In the fully discharged condition the same battery will read 1.175 approx. After the initial charging, the specific gravity of the electrolyte will drop by something of the order of 0.001 per day. If you work out a few little sums you will arrive at the conclusion that the battery will be fully discharged after a period of three months—which is correct!

Taken over a long period, it is unlikely that you will require your record-playing facilities for more than five hours per week. Occasionally it will be more but on the average it is likely to be less.

RECHARGING

Assuming for a moment that it is five hours per week, after three weeks 60 AH of the battery's capacity will have been used and in addition something of the order of 20 AH wasted through self discharge. In other words, a small battery would require charging every three weeks where the equipment was in frequent use. A large battery, when the equipment is not in such frequent use, may require charging only every six weeks.

We do not advise leaving it any longer than about two months, even if the equipment is unused, because the life of the battery will be seriously prejudiced if it is allowed to stand in a discharged condition for long periods.

By means of a few simple sums you should be able to work out how large

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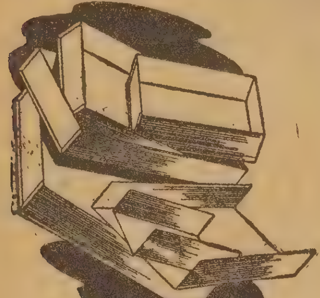

ALUMINIUM CHASSIS

POST FREE	PART No.	PRICE
6 x 4 x 2 open	3C7	5/5
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10 x 6 x 2½ welded	3C11	12/-
11 x 8 x 2 welded	3C12	14/-
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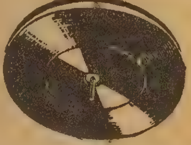
17 x 8 x 3 welded	3C15	22/6
17 x 10 x 3 welded	3C17	24/6
17 x 12 x 3 welded		26/6

Chassis made to special sizes 50% more.



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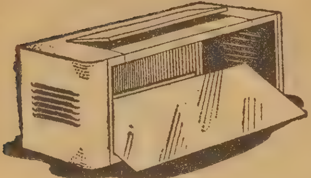
* * *



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Lift up lid, rounded corners. In Grey or Black krinkle finish. Size 15in x 8in x 7in. PART No. 3C18, £3/5/-
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Add Postage VIC, 3/8; NSW, ACT, SA, TAS, 6/-; QLD, WA, NT, NG, 8/4.
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This weighs over 11lb and is sent Freight Forward, Rail or Air as ordered.

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1A4P	34/-	5W4	21/-	6G6-G	25/9	12AT6	21/3	50L6-GT	19/9	B250	28/-
1A5-GT	19/9	5X4-G	20/-	6G8G	22/9	12AT7	32/6	53	26/9	B605	25/-
1A6	30/9	5Y3GT	16/3	6H6GT	21/9	12AX7	26/3	55	22/3	CF1/SP13	25/6
1A7-GT	26/9	5Y4-G	17/9	6J5-GT	23/3	12BA6	22/3	57	22/9	CK1	26/6
1B5/25S	25/9	5Z3	18/9	6J6	27/6	12BE6	22/6	58	22/9	CL4	24/3
1C4	23/9	5Z4	25/-	6J7	20/-	12AU7	24/3	59	28/6	CY1/UR3C	23/9
1C5-G	21/6	6A3	33/6	6J7G	22/9	12J7-GT	22/6	71A	23/3	CY31	23/9
1C6	28/9	6A4	21/6	6J8G	28/9	12K8-GT	24/6	75	19/9	C1	22/-
1C7G	26/9	6A6	25/-	6J8GA	28/9	12Q7GT	19/3	76	19/9	E406N	24/-
1D4	22/9	6A7	22/6	6K5-GT	26/9	12SA7-GT	21/-	77	21/9	EB4	24/9
1D8-GT	29/6	6A8	21/6	6K6-GT	18/6	12SC7	22/6	78	21/9	EBC3	24/9
1E5-GP	32/-	6AB5/6N5	20/-	6K7-GT	23/-	12SG7-GT	21/-	79	26/9	EBC33	24/9
1F4	25/3	6AB7	26/3	6K8-GT	24/9	12SJ7-GT	21/9	80	15/9	EBF2	23/6
1F5-G	25/3	6AC5-GT	25/9	6L5-G	25/9	12SK7	18/9	81	37/-	EBF35	22/9
1F6	29/9	6AD8	20/-	6L6-G	26/-	12SK7-GT	22/3	82	25/9	EBL1	26/-
1F7-G	32/-	6AE8	21/9	6L7	24/9	12SL7-GT	23/9	83	24/9	ECC33	28/3
1G4-GT	23/9	6AG5	22/3	6M5	19/-	12SQ7-GT	19/-	83V	28/6	ECH4	25/-
1G5-G	25/3	6AG7	27/-	6N7-GT	25/-	12SR7-GT	20/3	84/6Z4	20/9	ECH33	27/-
1G6-GT	23/9	6AK5	30/3	6N8	20/-	12Z3	25/9	85	22/9	ECH34	25/-
1H4-G	21/6	6AL5	19/9	6Q7-GT	20/9	14AF7	23/9	89	22/9	EF6	25/6
1H5-GT	23/9	6AM5	24/-	6R7-GT	28/6	14C5	28/6	117Z6-GT	23/3	EF36	23/-
1H5-GT	23/9	6AM6	23/6	6S4	23/9	14C7	24/9	302	19/6	EF37A	27/9
1H6-G	27/9	6AM7	21/9	6S7-G	28/-	19	29/9	723A	75/-	EF5ON	32/6
1J6-G	18/-	6AQ5	19/-	6S8-GT	28/-	25A6-G	31/-	802	62/6	EK2P	27/9
1K4	17/9	6AR7GT	20/-	6SA7-GT	24/9	25AC5-GT	32/-	807	32/6	EK32	26/-
1K5G	11/6	6AS5	20/-	6SF7	21/6	25L6-GT	20/3	830B	85/-	EL2	25/6
1K6	23/6	6AU5-GT	26/3	6SH7	21/6	25Z4-G	18/3	834	120/-	EL3NP	26/-
1K7G	26/9	6AU6	19/9	6SJ7	18/6	25Z5	18/6	921	30/-	EL33	20/9
1L5G	24/9	6AV6	17/-	6SJ7GT	23/3	25Z6-GT	18/3	935	80/-	EL50	32/6
1M5G	25/6	6B4-G	35/6	6SK7	18/9	30	21/9	1561	25/6	EZ82	15/6
1N5-GT	32/-	6B6G	21/-	6SK7GT	23/3	31	25/9	1626	25/-	FC2A	25/-
1P5-GT	32/-	6B7	22/6	6SL7GT	26/3	32	29/9	1805	22/3	KC3	25/-
1Q5-GT	23/9	6B7S	22/6	6S67GT	26/3	32L7-GT	32/6	1941	15/6	KC4	25/-
1R5	20/-	6B8	28/6	6SQ7GT	20/9	33	29/9	1954	19/6	KDD1	25/-
1S4	21/-	6B8G	22/9	6ST7	25/9	34	29/9	7193	31/6	KT61	20/9
1S5	18/5	6BA6	19/6	6T7-G	28/9	35	22/6	7475	25/-	KT66	27/9
1T4	18/6	6BD7	17/-	6U5	18/6	35LGT	21/6	9001	26/6	N78	19/-
1U5	18/6	6BE6	19/9	6U7G	22/3	35W4	18/-	9003	28/6	PM24M	25/-
1V	21/6	6BG6G	40/9	6V4	15/6	35Z4GT	17/3	9004	23/-	SP2M	25/-
2A3	28/6	6BH5	19/6	6V6-GT	20/6	35Z5-GT	15/9	8018	32/6	SP13	25/-
2A5	23/-	6BV7	19/6	6X4	15/6	36	25/9	QS-95/10	33/7	EL34	31/-
2A6	25/-	6BW6	19/-	6X5GT	17/-	37	20/9	OC3/VR105	37/10	EL35	28/6
2A7	23/9	6C4	23/3	6Z7-G	33/3	38	22/9	OD3/VR150	35/11	EM4	21/-
2B7	24/9	6C5-GT	21/6	7A6	22/9	39/44	25/9	A109	25/-	TDD13C	23/9
3Q4	21/3	6C6	23/-	7B8	21/-	41	19/9	A425	25/-	UBL1	27/-
3Q5-GT	21/6	6C7	22/6	7C7	21/-	42	23/-	A442	25/-	UF9	23/2
3S4	18/6	6D6	21/-	7W7	33/3	43	21/9	A642	25/-	UY1(N)	21/9
3V4	18/6	6D8-G	29/9	12A6	23/-	45	21/9	ABC1	24/9	X61M	27/-
5R4GY	32/6	6F5-G	19/9	12A7	29/6					1561	25/6
5T4	32/-	6F6	22/9	12A8-GT	21/6	47	24/3	AK2	26/-	1805	26/-
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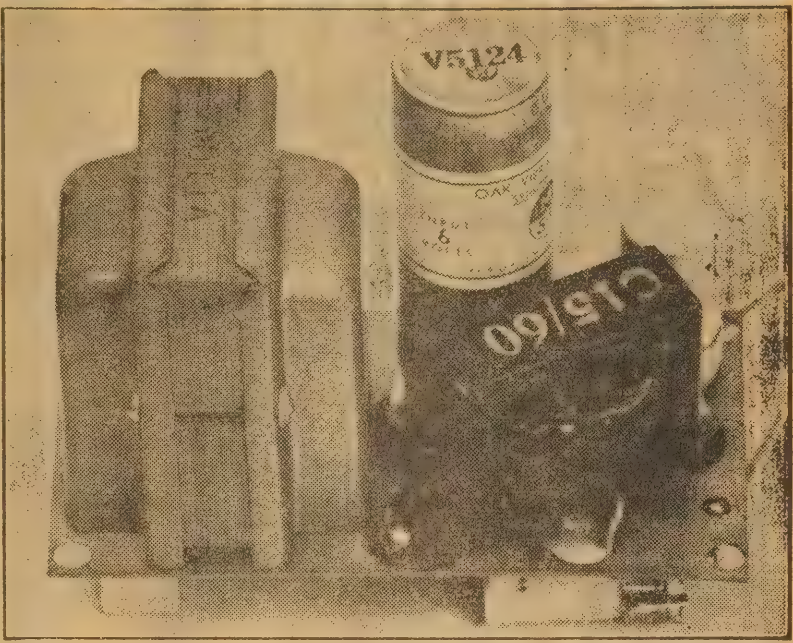
TOP VIEW OF VIBRATOR SUPPLY



This picture shows the position of all major components on the power supply mounting plate. The power supply is built using the shield box and mounting plate originally specified for the Radio and Hobbies "Karset."

a battery you will require. It seems that the largest of the generally available radio batteries is the 11-plate job which has a capacity of about 150 AH. Between this and the 9-plate there is the 13-plate with a capacity of 130 AH and the 11-plate with a capacity of 110 AH.

There will be plenty of cases where a large battery is not warranted because the ampere hours wasted through self discharge go up with the capacity of the battery.

The previous discussion will apply mainly to those who visit town every so often and who simply drop the battery into the service station for charge. Some readers may have cars, trucks or farm vehicles which are in frequent use and be prepared to change the radio battery with the vehicle battery at fairly frequent intervals.

CAR BATTERIES

If the vehicle's generator and voltage regulating system are in good condition, a few hours' running will serve to bring the battery up to full charge. But the scheme will only be satisfactory if the batteries are exchanged with sufficient frequency to obviate any possibility of the vehicle being disabled due to an ineffective battery.

While it is a nuisance changing batteries every so often, it may enable you to have entertainment which would otherwise be impossible.

On the other hand, you may have to depend on a garage to keep the battery charged. In this case, short of having two batteries, you will simply have to do without the amplifier every so often.

In addition to the difficulties of powering the amplifier itself, the country record enthusiast is up against a major problem in the matter of powered turntables. Frankly, we cannot offer any cut and dried solution.

As far as we know, there are no turntables which will work from battery power available through the normal trade channels. Few readers will have the special tools and skill required to make up a special turntable.

Spring turntables are not a complete solution. While there are plenty of excellent smoothly running spring turntables, the best of these has a maximum playing time of about 10 minutes at 78 rpm. Few have a sufficiently good governor system to allow them to be slowed down to 33 1-3 rpm in a satisfactory manner.

There are such things as reduction turntables but they still do not allow the 20 minutes or so playing time required for microgroove recordings.

LP DIFFICULT

It seems that we can depend only on the standard 78 rpm records for the time being. Perhaps in the not too distant future some enterprising manufacturer will turn out a suitable turntable but for the moment we will simply have to take a realistic view of the situation—a spring motor and 78 rpm records.

The pick-up position is far happier. There are several excellent crystal pick-ups on the market at very reasonable prices. They all have characteristics designed to compensate for the attenuated bass characteristic of standard recordings while the response at the high frequency end of the range is far ahead of the crystal pick-ups of a few years ago.

Stylus pressure is down to a low figure and permanent sapphires obviate the bugbear of needle changing. The new crystal pick-ups also have good compliance, which together with the low stylus pressure, means long record life.

Those who have been accustomed to the record crushing crystal and magnetic pick-ups of the last decade are in for a pleasant surprise when they first hear the new crystals. The lightweight magnetics and such things as "Playmaster" control units all have their place, but the owner of a good crystal pick-up with a straightforward amplifier gets a lot of good quality per pound.

RESISTOR COLOR CODE

Value	Body color	End color	Dot color
250	Red	Green	Brown
1500	Brown	Green	Red
.05	Green	Black	Orange
.5	Green	Black	Yellow

As a matter of fact many of the modern crystal pickups can fairly easily be compensated and applied to a "Playmaster" control head where full flexibility is required. We intend having more to say about this next month.

We now come to the details of the amplifier itself. The power output stage is the logical place to start since it determines the power supply requirements.

Any one of the beam tetrodes previously mentioned is equally suitable from the electrical point of view and may be used in the circuit without change to the constants. We chose the 6AQ5. A 6AU6 which is of the same miniature series as the 6AQ5 serves well as a voltage amplifier, its high gain allowing plenty of feedback to be applied to the output stage.

Bias for both valves is obtained by the simple procedure of placing a resistor in series with the cathode as is usual with AC operated amplifiers. An electrolytic condenser is used to bypass the resistor in each case to avoid degeneration. The use of back bias would have complicated the vibrator power supply without gaining any advantages.

The 6AU6 voltage amplifier obtains its high tension supply through a decoupling network consisting of a .05 meg resistor and an 8 mfd condenser. Actually the amplifier performs quite well without the decoupling but in some cases it will serve to remove the last trace of vibrator interference so that its inclusion is well worth while.

Feedback is applied by the well tried and simple procedure of connecting a resistor between the plate of the 6AQ5 and the 6AU6. Thus it is effectively over the output stage only. A relatively low value of resistor is required to give the required degree of feedback, in fact .5 meg, so that instead of the usual .25 meg plate load resistor, .5 meg is used. As far as the direct current circuit is concerned the two .5 meg resistors are in parallel.

USE 1 WATT RESISTORS

By the way, don't be tempted to use ½ watt resistors in any of these positions. The acutal dissipation is well below ½ watt in most cases but the 1 watt units have proved themselves much more reliable in positions where they are required to carry current.

The feedback loop does not include the output transformer as was the case with our "Playmaster" amplifiers. This allows a wide choice in the matter of speakers and speaker transformers. You can use a special high quality transformer if you like, in fact there is a special place on the chassis for it, or you can simply use

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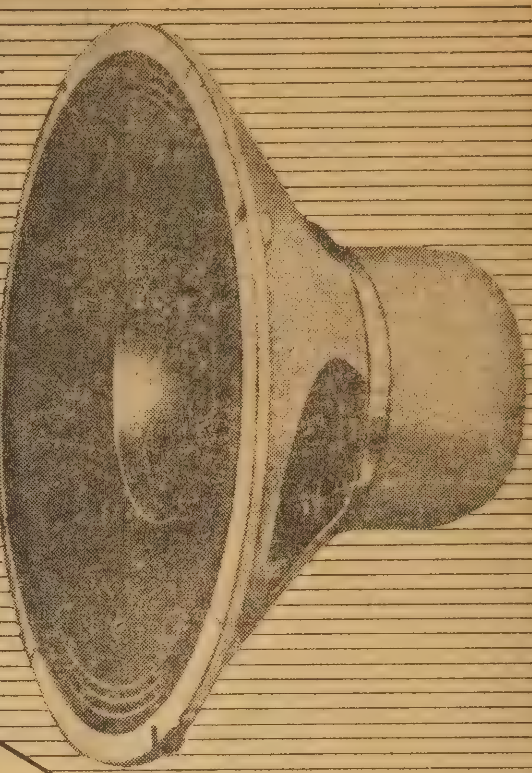

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the transformer attached to the speaker.

If you decide to have the speaker transformer seperate from the amplifier, always be careful to see that it is plugged in before the amplifier is switched on. Should you fail to do this, the high tension voltage will be applied to the screen of the 6AQ5 with virtually nothing applied to the plate with disastrous effects on the life of the valve. There may be some argument for wiring the power leads in series with the two spare pins on the speaker plug. The circuit can then be completed by a link in the speaker plug making it impossible to switch the amplifier on with the speaker disconnected.

INPUT CIRCUIT

Connection to the input of the amplifier is made through a pair of terminals mounted on the front of the chassis. The volume control is connected in the input circuit also because the output of plenty of the crystal pickups would be high enough to overload the valve if applied directly.

The remaining control on the right of the chassis front is the tone control. It operates in the grid circuit of the 6AQ5 and serves to attenuate the high frequencies when necessary. You will find it useful when playing worn records. There will be some who will require more elaborate tone control arrangements and we will have more to say about this later.

The mechanical layout of the amplifier is by no means critical. Any chassis which allows room for the vibrator box, the two valves and the controls will be suitable. Therefore, rather than burden the chassis manufacturers with yet another design, decided to use the chassis originally specified for the "Playmaster" No. 3 and then the "Playmaster" No. 4.

Several of the unused holes will be covered by the vibrator box while scrap metal can be used to make disguise plates for the remainder. If the whole job is given a coat of enamel afterwards, there is no reason why it should not look as neat as any factory made job.

You will have to drill six extra holes in the chassis altogether but this should not cause any undue hardship. There are four extra holes on top of chassis for mounting the vibrator box and two holes on the front of the chassis for the pickup terminals.

The valve holes are punched for standard octal sockets but again this does not cause any difficulty because adaptor plates are readily available.

MECHANICAL DETAILS

The vibrator power supply for the amplifier is built in the box specified for the 1952 "Karset" which is now a standard item available from all the usual radio supply houses. Most of them are quite willing to sell the vibrator box and mounting plate without the chassis and box for the "Karset" proper.

The mounting plate will have all the required holes punched but the manufacturers don't usually make any provision for attaching the top and bottom of the box to the sides. You can do this yourself, either with self tapping screws or with ordinary 1-8in whitworth bolts. In the latter case, of course, you will need a 1-8in tap and tapping drill.

Four bolts, each at least 2in long, are required for mounting the vibrator box. The same bolts also hold the inner mounting plate. Following our standard practice, the amplifier chassis makes contact with the vibrator box at one point only and likewise the vibrator box makes contact with the inner mounting plate at a single point.

The latter point is used as a return for all components mounted on the plate except the electrolytic condensers. With most types of electrolytics it is mechanically difficult to insulate the can from the chassis. However, this does not appear to matter.

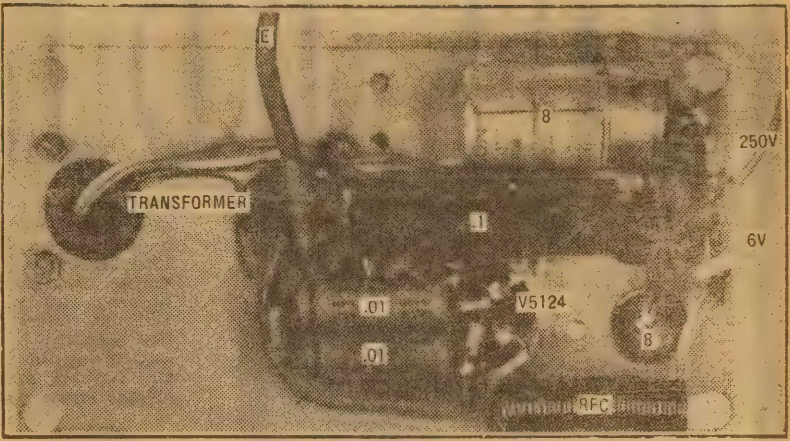
In assembling the components on the mounting plate, we suggest you start with the transformer. A couple of large rubber grommets are required to prevent the wires rubbing across the sharp edges of the metal where they come through the plate. Turn the transformer so that the primary leads come through the hole nearest the vibrator socket. The vibrator socket should be turned so that pins 1 and 5 are nearest the transformer.

The transformer mounting stud nearest the valve socket can conveniently be made the common earth return point. Three or four solder lugs can be secured under the nut because there are a large number of connections to be made to the one point.

Despite the rubber insulation inside the can, there is inevitably a certain amount of mechanical vibration associated with vibrators. This can be minimised by mounting the vibrator socket on rubber.

A couple of the soft rubber grom-

UNDERNEATH VIEW OF VIBRATOR



If you follow this photograph, you won't have the slightest difficulty in fitting all the components underneath the vibrator mounting plate. Note the common earth point alongside the vibrator socket.

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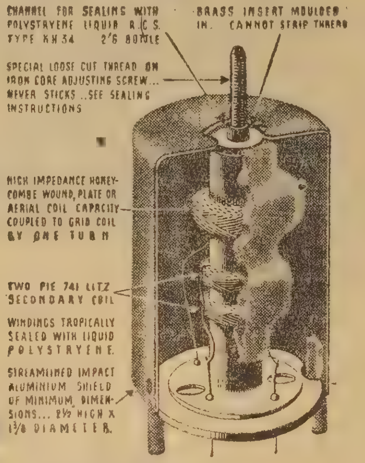
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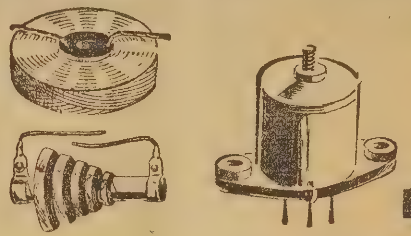

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E353 Mgt. Mag. B/C Aerial.
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H131 40 Metre R.F.
H132 40 Metre Oscillator.
H133 80 Metre Aerial.
H134 80 Metre R.F.
H135 80 Metre Oscillator.
H136 B/C Aerial.
H137 B/C R.F.
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mets of the type used for mounting tuning condensers are suitable. Place them in the holes alongside the socket hole, then the 6-pin socket (which must have a flanged mounting plate) on top. The socket is then secured to the grommets by means of a pair of 1-8in bolts.

We recommend a pair of washers, one under the nut and one under the head of the bolt, to distribute the load over the area of the grommet.

In order to save the additional current drain and cost of a rectifier valve, we have used the synchronous vibrator type V5124. This vibrator has a second set of contacts which move in synchronism with the primary contacts and are thus able to rectify the output of transformer.

POLARITY IMPORTANT

Unlike the simple vibrator and rectifier combination, the supply current for a synchronous vibrator must be correctly polarised.

If you reverse the connections to the battery or either to the primary or secondary contacts of the vibrator the polarity of the high tension supply will be reversed.

We suggest, therefore, that you leave the leads to the secondary contacts a few inches longer than actually required (these are usually the easiest to handle). Then, having decided which way you want to connect the battery apply the power for a few seconds. A meter connected across the high tension line will give you the polarity of the high tension, and if it is incorrect you simply have to reverse the connections to the vibrator secondary before soldering them in permanently.

If you don't have a meter the problem is a little more difficult. Electrolytic condensers have a definite polarity, and if they have to withstand currents in the wrong direction they are likely to break down very easily. However, if you break one connection to each of the three electrolytic condensers, the amplifier can be switched on without doing any damage even if the polarity happens to be incorrect.

Without the electrolytics there should be some sign of hash in the speaker after about 30 seconds. If not, you can take it as an indication that the polarity is incorrect and the leads to the secondary contacts should be reversed. If there is no hash with either connection you can take it as an indication that there is something else wrong. Reconnect the electrolytics as soon as you have established the correct polarity.

Three wires connect the vibrator unit with the rest of the amplifier. A length of copper braid (the outside of ordinary shielded wire may be used) is used to make the connection from the common earth point on the mounting plate to a single point on the box and then to a point on the chassis.

EARTH RETURN

The section of the lead from the common earth point to the box should be about 5in long and covered with insulating tubing so that the mounting plate can be removed and inspection of the components underneath carried out without disturbing the wiring.

Two other leads, one carrying the 6V primary supply and the other carrying the outgoing high tension, are required and these can be made of such a length as will allow the underneath components to be inspected.

The long bolts used to hold the supply in place are insulated from the chassis by means of fibre washers in order to preserve the single point return system. You will need two large and one small washer at each insulating point and the hole in the chassis should be the same size as the small washer in each case.

Pass the bolts up through the chassis and secure them by means of a nut, the nut being on top of the chassis. Then slip the bottom of the vibrator box over the bolts and secure. The box will be electrically connected to the bolts. Using the same insulated washer technique as previously, mount the plate on the long bolts at such a height that the components underneath it just clear the bottom of the box.

Having done that, you can screw the rest of the box in place. From then on the vibrator supply may be regarded simply as a device for converting 6V DC into 250V DC.

Some commercial amplifiers employing vibrator supplies do not employ the technique of using a separate box and mounting plate. However, in all such cases you will find that a lot of research has gone into component placement, earth returns, &c., in order to get a hash-free amplifier.

Most readers will prefer to follow the technique outlined, which can be depended upon to give excellent results.

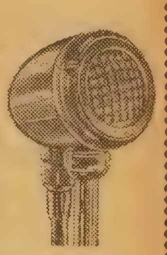
Although we have not actually tried it, we see no reason why the amplifier should not work just as well with a 12 or 24-volt vibrator supply. It would simply be necessary to substitute a 12 or 24-volt vibrator and appropriate transformer for the components specified. The valve filaments would have to be wired in series and a 42 ohm resistor wired in parallel with the 6AU6 filament in order to bypass the additional current required by the 6AQ5

Should you wish to operate the filaments from a 24-volt supply, the network described above should be connected in series with a heavy duty 28 ohm resistor.

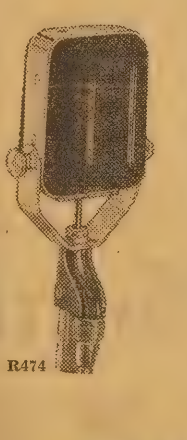
Some readers will be wondering just how far they can extend the battery lead without causing excessive voltage drop, so we made a few tests with ordinary plastic power flex which consists of 23 strands of .0076in diam. wire. It appears that anything up to about 8 feet of this is in order if one conductor is used for the positive and the other for the negative lead. For one test we connected the amplifier to a fully-charged battery through 20 feet of

(Continued on page 95.)

HM



B110



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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

TRANSFORMER-COUPLED PUSHPULL 2A3 AMPLIFIER

For this month we have selected a couple of amplifier circuits which, although widely different in terms of power output, are much alike in their constructional simplicity.

THE first circuit was submitted by Mr. W. J. Farrow, of 9 Dickson Av., West Ryde, NSW.

It consists of two triode stages of voltage amplification transformer-coupled to a pair of 2A3 power triodes in push-pull. The sensitivity should be sufficient for standard magnetic and crystal type pick-ups and even some lightweight magnetics, provided that they are used with their associated step-up transformers and/or filters.

Obviously bass compensation for magnetic pick-ups to take the usual recording characteristics will need to be added, and one of the Radio and Hobbies Playmaster series of Control Units could be used to take care of everything. Incidentally, the general discussion in the article on the Playmaster No. 3 (2A3 Output) of June, 1952, may be of some interest.

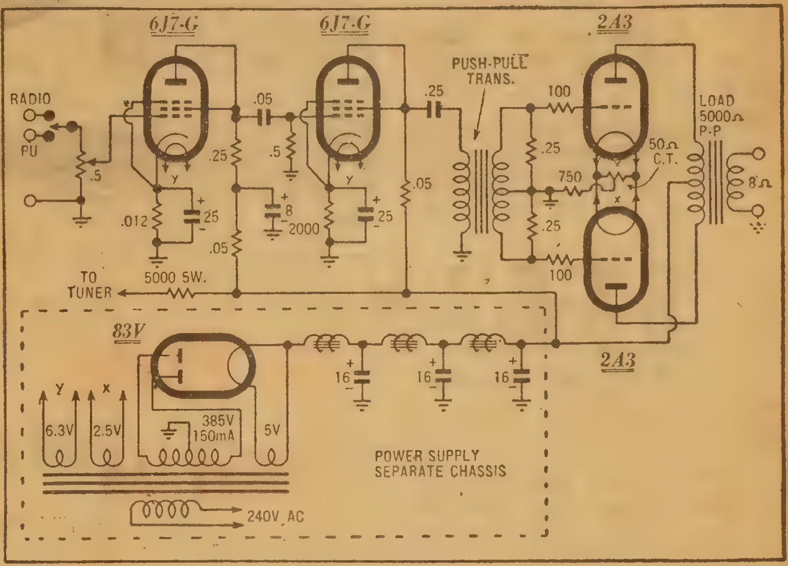
The power output from this amplifier will be in the range of from 6 to 8-odd watts.

HIGHER OUTPUT

Higher output can be obtained by omitting the first filter choke from the power supply, thus rendering the filter capacitive-input. The resulting increase in high tension voltage together with a appropriate increase in bias, will be running the 2A3's right on their ratings and, if the amplifier is to be operated at full output, it would be wise to check the two output valves for plate voltage and current.

The first two stages use triode-connected 6J7G valves. The suppressor may, in this case, be connected either to the cathode or to the plate and screen. We increased the value of the cathode bias resistor for the first valve to .012 megohms, this being the value suggested by valve data sheets for the circuit conditions. If you cannot make up that value with resistors on hand. you will get by with a .01 megohm. The value of 2000 ohms for the second stage cathode resistor is in order, although, if anything, it could be a little lower.

The interstage coupling transformer should be one designed for the job and of good quality, if you want to keep the frequency response up at both the lower and upper ends. Cf course, the quality of the pick-up and speaker (including its transformer) will decide you on this point. Our contributor used a Ferranti type AF5C to feed the 2A3's.



The power transformer rating of 150 mA is liberal, and you could use a 125 mA rating if you have one on hand. The 5V4G is electrically similar to the 83V rectifier. The dropping resistor value for the tuner high tension may need adjustment, depending upon the current drain of the tuner to keep the voltage supplied to it around the 250 mark.

SIMPLE BATTERY AMPLIFIER

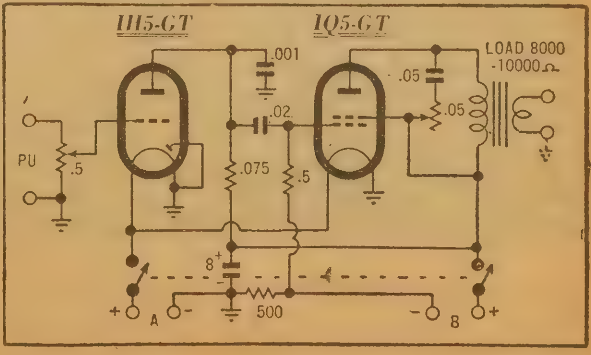
The second circuit comes from Mr. J. T. Johnstone, of Guernsey St., Scone, 4N, NSW.

It could be constructed on a chassis of very small dimensions if desired, particularly, if the 7-pin miniature valves are used. For instance, a triode-connected IT4 could be used in the first stage and a 3V4 in the output stage. The sensitivity would be reduced a little, but could be more than retrieved if the 1T4 were connected as a pentode with a .5 meg plate load resistor and a 1 megohm screen resistor bypassed at the screen.

The standard high output pick-ups should be used with this unit. For the standard magnetic pick-up, a resistor of about .05 megohm should be placed across the input terminals.

We have increased the B plus bypass from .1 mfd to 8 mfd. For a B battery in good condition, this 8 mfd will adequately bypass the 500 ohm back-bias resistor. In the circumstances, both the A plus and the B plus leads should be broken by a double-pole switch.

The power output for 90 volt operation should be of the order of 250 milliwatts. Even allowing for the inevitable loss in the speaker transformer, this output can sound fairly loud on a large modern speaker for one-room operation.



500-OHM LINES—WHY USE THEM?

A subject which frequently confuses the beginner, particularly those interested in audio reproduction, is that of transmission line impedance. Engineers speak so frequently of "a 500-ohm line" (or a line having some other value) that it is obvious the subject is an important one, yet, for the beginner (and, I sometimes suspect, for the more advanced enthusiast) it is one which remains shrouded in mystery.

by Philip Watson

WHY do we use a 500 ohm line? How does it help? How do we arrive at its value?

All these questions, and others, present themselves when the subject is raised and in this article we hope to discuss the subject from the beginner's angle and give you a complete picture of what it is all about. In order to make it as simple as possible we propose to divide the discussion into four sections: DC, low frequency AC (50 cycles, &c.), audio, and RF.

What is more, we propose to approach the discussion from a rather unusual angle.

Let us commence with the general statement that the purpose of selecting a certain line impedance is to minimise the losses which inevitably occur in any electrical transmission line.

LINE LOSSES

Having said that much, let us proceed to investigate each of these losses; their effect on the signal, and how they may be minimised.

Since the transmission of signals over a wired circuit is, after all, only the transmission of electrical energy from one point to another, we may logically commence our investigations with one of the simplest possible transmission systems, namely a battery and a lamp connected together by a pair of fairly long leads.

What are the possible losses in such a transmission line? Probably the most obvious one will be the natural resistance of the leads and, since this will be effectively in series with the load, it may be conveniently grouped under the heading "series losses."

The only other loss will be due to whatever leakage resistance may be present between the wires (due to ineffective insulation in one form or another). Since this will be in parallel, or shunt, with the load it may be placed under the heading "shunt losses."

Both are quite simple quantities. Shunt resistance can be measured with an ordinary ohmmeter, while series resistance can be predicted by reference to ordinary wire tables.

Just how important each of these losses will be in our simple transmission line will depend on a number of factors and it is in considering these that we get our first clue as to what this line impedance business is all about.

First, let us assume that we wish to provide 10 watts of energy in our lamp and, quite naturally, that we do not wish to waste any more power than necessary in our line. If we remember that wattage is the product of voltage and current, we can appreciate that we may provide the required 10 watts by means of a low voltage and a heavy current flow, a moderate voltage and a moderate current flow, or a high voltage and a low current flow.

Now how do each of these arrangements compare in the matter of line losses? Let us assume the resistance of the line is .5 ohm and that we are considering the first arrangement of low voltage and high current.

If we use a two-volt battery and lamp the required current to give 10 watts will be 5 amps and from these figures we can, in turn, determine the resistance of the lamp. This works out at .4 ohm, making the total resistance across which the two volts is applied .9 ohm. (.5 ohm line resistance, plus .4 ohm lamp resistance.)

Thus it is easy to see that more energy will be wasted in the line than will be usefully employed in lighting the lamp and that, for a line resistance of this value, the chosen voltage and current arrangement is quite unsuitable.

Suppose, instead, we use a 20-volt battery and lamp, what then will be the effect of the line resistance? The current flow to give 10 watts at 20 volts will be .5 amp and we calculate the resistance of the lamp as 40 ohms. From this it is easy to see that the resistance of the lamp is now so high compared with that of the line that practically all the energy will be concentrated on lighting the lamp and the line losses will be negligible.

Thus, without altering the characteristics of the line itself, we have made it perform the job we required simply by choosing a better ratio of current and voltage.

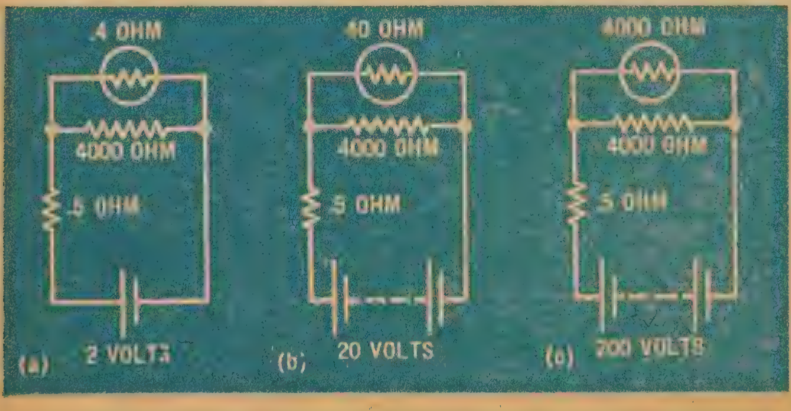
But before jumping to any hasty conclusions, let us alter the voltage current ratio once more and note the effect.

HIGH RESISTANCE

If we use a 200-volt battery and lamp we find that the current is now only .05 amp and the lamp resistance is therefore 4000 ohms. It is obvious that the .4 ohm line resistance is no longer of any significance, compared with the lamp resistance, and that series losses have virtually ceased to exist.

However, we are approaching the point where consideration will have to be paid the shunt losses. Although proper insulation technique will normally keep these very low, let us suppose that, due to factors such as damaged insulation, moisture, &c. the resistance between the wires is 4000 ohms. This is equal in value to the resistance of the lamp and, since it is shunted across it, the loss will again be serious.

In the two previous examples this shunt resistance would have been so much higher than the load that the effect would have been negligible.



The problem of power transmission illustrated by simple DC circuits. In (a) and (c) the losses are prohibitive but the intermediate impedance of circuit (b) ensures quite low loss.

Very obviously, the 20-volt 0.5-amp condition is the best.

Several interesting points arise from all this. One is the relative ease with which line resistance figures can be assessed and compared with the effective resistance of the load.

Then again, by speaking of "the effective resistance of the load," we are indirectly referring to the voltage/current ratio. Therefore, a suitable load for a particular line automatically means suitable values of voltage and current.

Finally, the line and load are interdependent to the extent that there is a broad optimum figure of load for any given line; conversely, if the load is fixed, then the line can be chosen to transmit the power to best advantage. If the losses are low, the net impedance looking into the line will be substantially the resistance of the load.

These generalities hold for DC circuits and, in fact, for low frequency AC circuits. For the transmission of radio frequency energy, however, a more specialised approach is necessary, as we shall see later.

LOW FREQUENCY AC

From the DC circuits we pass to AC at 50 cycles or thereabouts. (Sometimes referred to as "commercial frequencies.") Here we find some excellent examples of the correct choice of voltage current ratio for efficient transmission; mainly in the high tension lines used to convey many thousands of kilowatts of power from the generating point to the consumer, who may be many miles away.

By far the greatest loss facing the power transmission engineer is that due to the resistance of the copper cable (series losses), while shunt losses, due to leakage across the insulators, although a problem, can be kept to a low value by correct design.

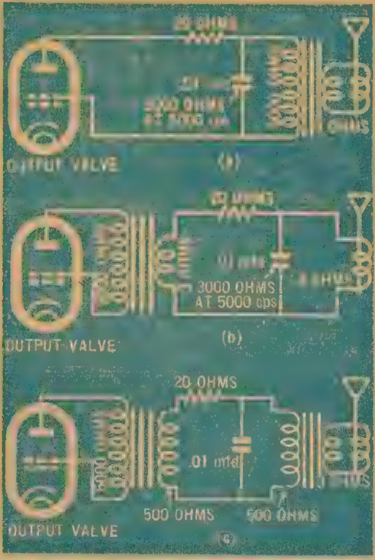
As with the DC circuit, series losses are least when the power is transmitted at a high voltage with relatively low current drain, so that normal practice is to step the voltage up to a high value at the generating point and then step it down again at the other end to a value suitable for industrial and commercial use.

By this means, line losses can be kept to a fairly low figure and, in spite of insulation problems, it is now customary to use voltages running into the tens of thousands and even hundreds of thousands. Although the transmission engineer would describe such a system simply as a high tension line, he has, in communication engineering parlance, used a relatively high impedance line.

AUDIO FREQUENCIES

So much for power frequencies. As soon as we have to deal with frequencies substantially higher than this and, in particular, with wide range of audio frequencies varying from, say 50 cycles to five or 10,000 cycles, we are faced with an entirely new set of conditions.

In addition to the original shunt loss due to leakage between wires, we now have a new shunt loss, that due to capacitance between the wires. In the matter of series losses there is also a new customer, that due to inductance of the wires. Of these two, the capacitance is the more serious, though the inductance cannot be completely ignored on very long lines.



Three ways of connecting an output stage to a loudspeaker: (a) at high impedance (b) at low impedance and (c) medium impedance. The last-named method is generally preferred where the speaker is at a considerable distance from the amplifier, as in a theatre or a large P.A. installation.

Unlike shunt losses due to leakage resistance, those due to capacitance are no tdependent on insulation, so that the engineer has very little control over them. It is possible to reduce the capacitance by increasing the space between the wires, but, obviously, there are limits to the extent to which this may be done.

The worst aspect of these two new losses is that they are frequency-conscious. In other words, the actual degree of loss varies with frequency, thus making it extremely difficult to transmit all frequencies with equal efficiency. A few simple examples may help to make this clear.

Suppose we have an amplifier feeding into a speaker transformer of 5000 ohms impedance and we want to operate the speaker at the other end of a very long line having capacitance in the order of .01 mfd and a resistance of say 20 ohms.

500-OHM LINES

One approach would be to connect the plate circuit of the amplifier output valve to one end of the line and the speaker, with its transformer, to the other. This will create a 5000 ohm line. Such a set-up will work after a fashion, but there will be serious attenuation of the higher frequencies and some impedance figures for a .01 mfd capacitor will show why.

At 50 cycles the impedance is approximately 300,000 ohms, which is so much higher than the load impedance (5000 ohms) that the shunt effect on it is negligible. However, at 5000 cycles the impedance is only 3000 ohms (approx.), which is low enough to bring about serious losses at this frequency. At 10,000 cycles the shunt impedance has dropped to 1500 ohms and the greater portion of the energy would never reach the speaker.

Thus it is easy to see that at 5000 ohms a line of these characteristics would suffer most from shunt losses in the form of capacitance between the wires. The 20 ohms series resistance of the line would be negligible compared with the 5000 ohms of the load.

Looking at it another way, and returning to our original DC example, we may say that the required power is being transmitted under conditions of high voltage and low current, which arrangement, you will remember, suffers very little from series losses but considerably from shunt losses.

ANOTHER APPROACH

Suppose we try another approach. Let us remove the speaker transformer from the speaker and mount it on the amplifier chassis, connecting the secondary winding to the line. Assuming the speaker voice coil has an impedance three ohms we have now created a three-ohm line.

This will very effectively eliminate all shunt losses due to capacitance, simply because this shunt impedance, even at 10,000 cycles, is several hundred times greater than the load it is shunting.

However, there's a catch. The 20 ohms resistance of the line, representing our series losses, is now several times greater than the load and so will absorb most of the power. Reverting to our DC example again, we may say that the power is being

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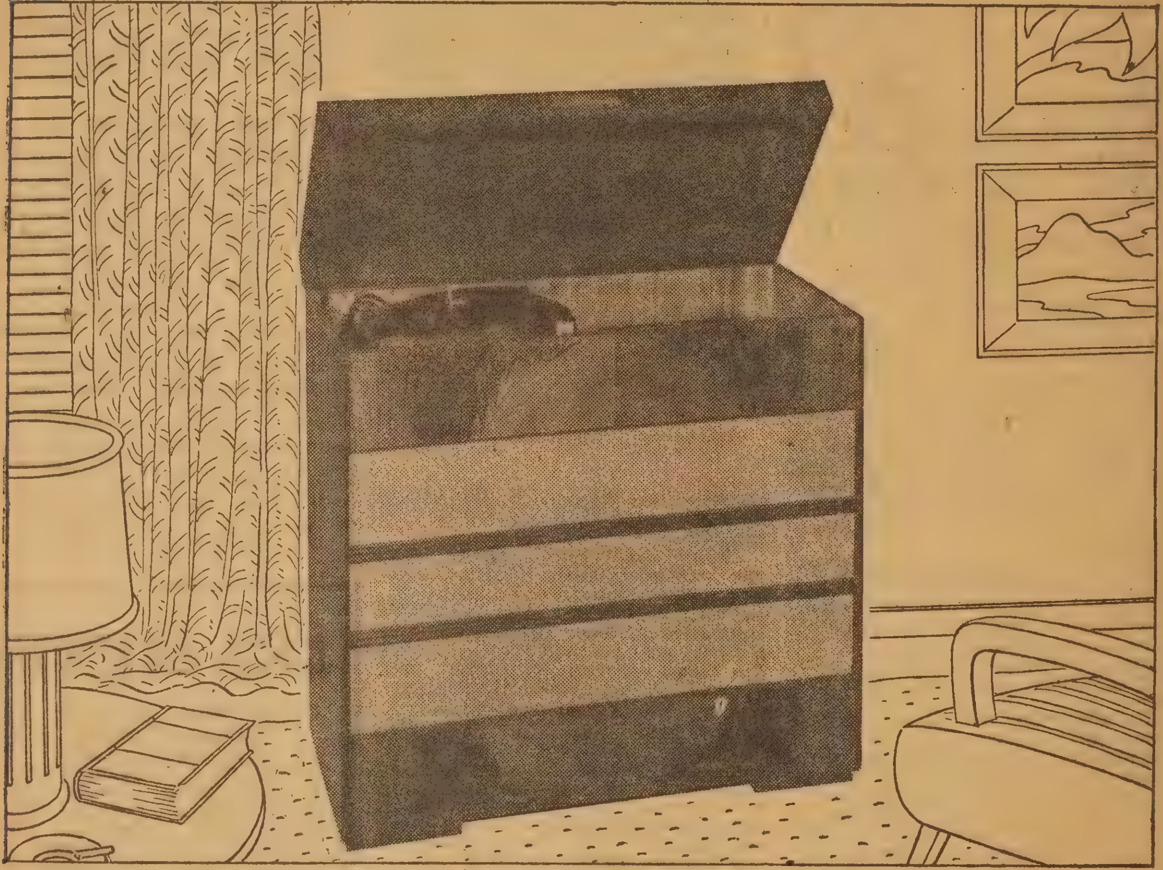

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transmitted at a low voltage and high current, a set of conditions which we found suffered most from series losses.

As we found in our DC example, it is possible to minimise both series and shunt losses by transmitting the power in the correct ratio of voltage and current, and this is exactly how we propose to overcome the present problem. As you have probably guessed, this is where we come to the 500-ohm line, which term is only another way of expressing a convenient voltage current relationship.

To produce the 500-ohm line condition we connect the output of the amplifier to a line transformer which has a 5000-ohm primary and a 500-ohm secondary. The primary connects to the plate circuit of the amplifier and the secondary to the line, while the remote end of the line connects to another transformer having a 500-ohm primary and a three-ohm secondary.

LOSSES MINIMISED

Now let us examine the effect of the line losses on this system. The shunt impedance at 5000 cycles is still 3000 ohms, and this value across 500 ohms would cause very little loss, certainly only a fraction of that which it causes when placed across 5000 ohms. Even at 10,000 cycles the shunt is three times greater than the load and would have only a slight effect on signals.

The series losses, due to the resistance of the line, have also been reduced to negligible proportions, simply because a value of 20 ohms when compared with the load of 500 ohms is so small that it is of no importance.

Thus we may conclude that the effects of both series and shunt losses in this particular line have been reduced to almost negligible proportions simply by selecting a suitable line impedance or, if you prefer it, by selecting the correct ratio of voltage and current.

The natural question now arises as to whether line characteristics will always fit in so obligingly with the voltage current relationship created by a 500-ohm line. In general, the answer is yes, though it may be more correct to say that practical line construction fits in more readily with this impedance than with most others. Thus a line engineer finds it easier to design a given length of line for minimum losses if he works on the assumption of a 500-ohm impedance.

However, this is not to say that 500 ohms is the only value which is useful in minimising line losses. 50 ohms is a valuable figure when the shunt losses are likely to be high compared with the series losses, and this figure is frequently used in microphone and similar low level circuits.

EFFECT OF SHIELDING

The reason why shunt losses are likely to be high in these circuits is because of the need to use shielded cables. By the very nature of their construction, these cables will inevitably have a greater capacitance per foot than, say, a twisted pair. Thus, a comparatively short run of such cable, while having a low resistance, may well have a high capacitance, so that the major problem is one of shunt losses. Since these are at a minimum when the voltage is low and the current high, the 50 ohm impedance is a more suitable value.

With a knowledge of the basic principles involved, the amateur audio engineer will be in a better position to decide whether a high, low, or medium impedance line is best suited for a particular purpose and, considering that economics must always be allowed for, this really boils down to deciding whether it is necessary to employ special transformers or whether an available impedance may be made to do the job.

Take, for example, the case of the extension speaker. Should it be run at plate impedance, the voice coil impedance, or is an intermediate impedance justified?

In many cases the high impedance will be quite satisfactory, since the capacitance between wires will not be very great on a small run.

On the other hand, there are frequently other reasons why it is not convenient to extend the plate leads. Some of these would be: The use of a push-pull circuit, the inconvenience of a line with HT voltage on it, or the possibility of instability. The question thus arises as to whether the losses would be serious at the voice coil impedance.

If a fairly long run is involved the amount of resistance introduced may be a significant proportion of a two ohm voice coil circuit. In some cases, the correct choice of wire gauge for the extension may make all the difference between losses which are excessive and those which are negligible. Again, all else being equal, a 15 ohm voice coil would be preferable to one of two ohms.

EFFECT ON QUALITY

There is another very important point which arises out of this discussion. The 500 ohm (or any other impedance) line does not possess any magical properties which enable it to perform miracles with the final reproduction.

Its use does not automatically ensure (as some enthusiasts appear to imagine) that the reproduction will be better than if it had not been used. Its main purpose is to minimise transmission line losses and, if those losses are not present in the first place there is absolutely no point in changing the impedance. In fact, since additional high quality transformers are necessary to do this, it is complete waste of money unless the losses are serious.

Futhermore, since all transformers must introduce some losses, care must be taken to see that these are not greater than those which they set out to eliminate. If they are, one is faced with the ridiculous situation where considerable expense is involved simply to make the system less efficient.

* * *

Finally, we come to the RF transmission line. The factors involved here are more complex than those we have already dealt with, and a full explanation could well occupy as much space as we have already filled. Perhaps, in the near future, we may be able to devote a complete article to the subject, but, in the meantime, a brief glance at the problem may keep your ideas in perspective.

First and foremost, radio frequency currents passing along a line, tend to create magnetic and electrostatic fields, which radiate some of the energy into space. This loss by radiation, which can be ignored at power and audio frequencies, becomes serious at radio frequencies and demands special care in the design of the line.

PHYSICAL DETAILS

Not only must note be taken of the normal resistance and insulation properties, but, the diameter and spacing of the conductors must be carefully arranged.

When this is done, radiation from one lead tends to cancel that from the other, thus minimising the loss. At the same time, the size and spacing of the conductors affects their mutual inductance and capacitance and determines a quantity known as the "characteristic impedance" of the line.

Thus, for efficient transmission of RF energy, from say, a transmitter to an aerial, the engineer must consider not only the "load" represented by the aerial, but also the type of line which will carry the requisite current and voltage and yet have the correct "characteristic" impedance.

In other words, he must look to the matching of three devices — the source, the load and the line. The latter has to be accurately determined instead of being non-critical, as it is at the lower frequencies.

Such a requirement does not represent an exception to our earlier discussion, but merely an extension of it made necessary by the special nature of high frequency energy. But, perhaps you've had enough for one article.

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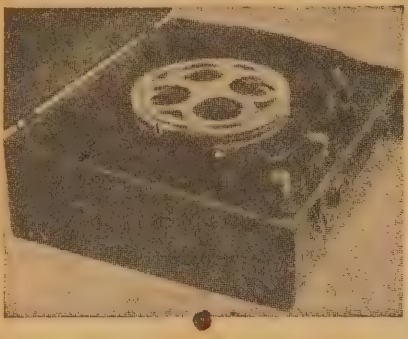

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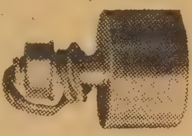

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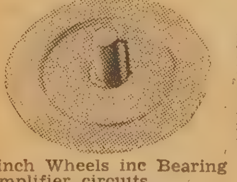

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I have frequently walked into the "Radio & Hobbies" office and gazed in silent awe as various members of the staff wrestled to "service" sets hundreds of miles away for a mere "two bob." Last week I had my turn.

IT seems that a friend of a friend had long enjoyed good radio reception from a rather remote but apparently excellent location "up country." I gather that he was using either a straight battery set or a standard commercial vibrator job.

Having apparently shorn many well-laden sheep, and being lured by talk of microgroove quality, &c., he decided to invest in a big, modern, 3-speed radiogram. There was no AC power available, but this could be solved, so the salesman assured him, by installing an inverter which would manufacture enough 240 AC from his 32-volt plant to run the radiogram, motor and all.

The necessary documents were duly signed and sealed and the equipment delivered to the spot. But alas and alack, while the "gram" portion worked fine, the radio reception from all but the most powerful stations was marred by a continuous "static" noise—known in better informed circles as vibrator hash.

There followed a series of exchanges and misgivings, plus solemn swearing by the inverter manufacturer that its output was completely filtered and couldn't possibly cause the trouble. But, of course, the trouble was still there. I gather that, by this time, the owner was beginning to say that "I hash had it."

At this stage, apparently, somebody remembered that he knew somebody that knew somebody that knew me. In other words, could I come up with an idea that would make the man happy.

WHAT IT COULD BE

Over the telephone I reasoned this way:

(1) The vibrator contacts might be feeding hash back into the 32-volt supply lines and radiating therefrom into the aerial.

(2) The hash might be getting into the 240-volt lead from the secondary vibrator contacts and radiating therefrom in to aerial lead-in.

(3) The hash might be feeding from the 240-volt supply straight into the receiver circuits, particularly via the rectifier and heater wiring.

Acting on these assumptions in order, I suggested first that the set owner inspect the 32-volt wiring to see whether it was grounded anywhere. If not, he was to ground the negative lead via a good and solid earth system, grounding also the metalwork of the engine and generator.

The other lead was to be bypassed to earth with a paper condenser. An 0.1 mfd tubular would do, but a metalcased type of larger capacitance would be even better.

(Later, he might have to try a low resistance type of line filter in the 32-volt circuit, but only as a last resort.)

Failing any beneficial effect from the earthing and bypass technique, the next step would be to purchase or make up a conventional 240-volt line filter and instal it in the lead between the inverter and the set. This might cut radiation from the power lead and also prevent penetration of hash into the receiver wiring.

Should the entire filtering technique fail to cure, or only partly cure the trouble, he could take one of two courses: Either start a fight to have the inverter rebuilt with better filtering, or instal a noise-reducing aerial system which would allow him to get the aerial proper as far as possible from the set and the wiring thereto.

Having opined in the matter, I promptly forgot all about it—until last week.

I then answered the phone to learn that my friend understood that his friend understood that the owner of the set was delighted beyond measure.

RADIATING "HASH"

The 32-volt wiring had not been originally grounded or bypassed in any way, thereby forming a very efficient radiator for the small amount of hash that did apparently leak out from the inverter.

So he had grounded the negative lead, bypassed the other one with a 0.1 mfd tubular and, as if by magic, every trace of the hash had disappeared. No line filter, no special aerial, no rows, no nuthin'!

As I gazed at myself next morning in the mirror I realised that the spirit of Lord Baden Powell still lived. In other words, "I'd done me good deed."

THE serviceman is still interested to hear about your experiences in meeting and curing unusual faults. Address your letters to "The Serviceman" C/- Radio and Hobbies, Box 2728C, GPO, Sydney. And don't forget to append your name, not for publication, but as a mark of good faith.

While in this strangely facetious mood may I let you into the secret that I have joined the ranks of the radio racketeers, blatant and unashamed?

Reason? I charged thirty bob yesterday for a piece of string.

But let me explain.

A man brought in one of those inexplicable sets called table models. Too large to stand on a shelf, too small to sit on the floor. You must have a table for them and the two items together take up the same amount of space as a real radio set. What am I saying?

This one, so the owner volunteered, needed my attentions because the "dial thing" wouldn't work. Nothing happened when you turned the knob but "you could still tune the stations by pushing on that round thing with a fork."

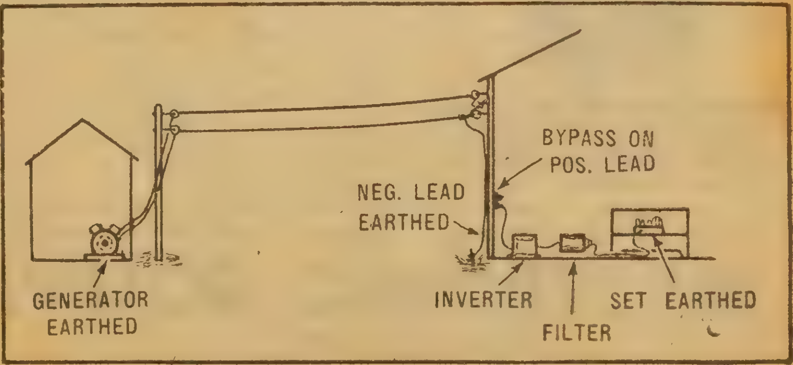
CORDS "IN SITU"

I groaned inwardly. Cord dials might be easy enough to repair on the bench, if you know exactly where the cord is supposed to go. But, in a strange set with the dial already in position and hopelessly tangled up with spindles and brackets and switches and dirt (organic and otherwise) the whole thing becomes an invention of the devil.

Well, I removed the chassis from the cabinet and then perforce had to remove from the chassis the dust of a bygone age. There was the cord hanging limply to the drum with not a clue as to which way it was originally run.

Patiently I had to work it all out. Anchored here, up over the pulley, twice around the pointer, over that pulley, back over this one, down to the knob spindle, up here and back there!

No, wait a minute. If I put it that way the pointer would run back-to-front and I'd have commercial programs on the national stations. Ad-



Things one could do to minimise hash problems in a 32/240 V. inverter installation. In point of fact, not all these measures proved necessary.

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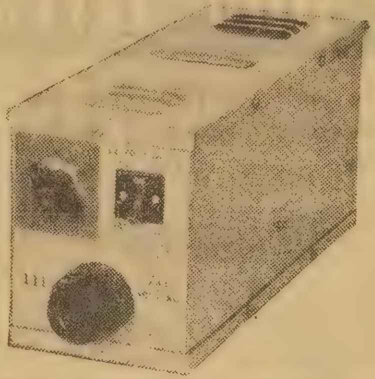

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Range 0-14 Amps
Scale Size — 4in.
Dia. Brand New

Price, each.

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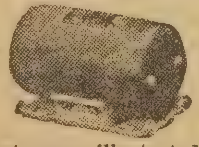

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TR1133 type, input 12 volts, output 300 volts at .24 amps, 150 volts at .01 amps, 6 volts at 5 amps. Filtered 90/-

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12v DC input.

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2mfd	1800vw	20/-	0.1mfd	2000vw	6/-
2mfd	1000vw	12/6	0.02mfd	8000vw	4/-
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NEW DUCON ELECTROLYTIC CONDENSERS

8 uF 525 PV
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erts over 2FC! That would never !

Well, let's start again. . . .

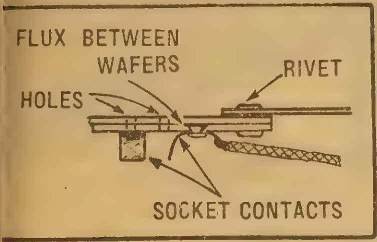
Ultimately I got the cord running e right way, but it kept running off e drum. Ah, yes, the "tune with a rk" treatment had bent the drum it of line. It was only a piece of m tin, anyway!

Then the knob spindle kept slipping. Apparently the cord had to n three times around the spindle, ot twice as I'd put it.

Okay. Take it all off and start gain. . . .

Ultimately I got it to work, nuffling the dial along till the pointer id the right thing.

Running over the broadcast band then noticed a vicious heterodyne n 2UE—one of the local broadcast ations. It was so bad that the ation could be received only by ning right off to one side. I vaguely emembered the client having menoned this fault some time back hen I met him casually on the social ounds.



A sure way to produce a breakdown a few years hence is to let flux run down inside a wafer type rectifier socket.

First step was to check the inter- ediate frequency and there it was . . absolutely dead on 475 Kc. Now, wice 475 equals 950 Kc, which is UE's frequency. No wonder the set vas whistling.

What apparently happens in a case ike this is that second harmonics rom the signal and from the oscilla- or combine to produce a component n the mixer output approximately qual to twice the intermediate frequency. In fact, the component vould pass right through twice the ntermediate frequency as the set is uned past a station.

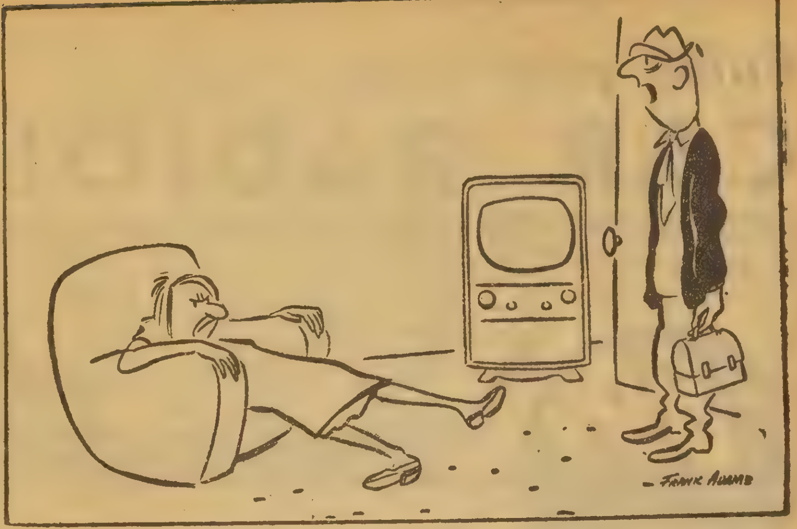
If it happens that the station's requency, also in the mixer plate ircuit, falls in the same range, a eat can occur. In this case, 2UE's requency was on 950 Kc, while the armonic product passed through his very same figure. A strong beat was inevitable.

TWO HOURS!

There was only one thing to do. I wrestled with the rather frail and heavily sealed IF slugs and managed to free them. The frequency was then eased down to about 465 Kc, which appeared to represent just about the limit of the tuning range available on the slugs. But it proved to be enough and, after aligning the trimmers, &c., 2UE's signal appeared in the clear.

It was just 9 o'clock when I started the job and exactly 11 o'clock when I wound the power cord up and pushed the set back on the shelf.

By the time I spend another quarter-hour with pleasantries, handling money and so on, the time involved won't be far off two and a half hours. Somebody's got to pay for it or I



"Television set break down, Mabel?"

starve, not to mention the rest of the family.

Fantastic, isn't it? 30 bob, "and all he did was put in one little piece of string. More than a penny an inch for string."

Imagine what they could make out of that in Parliament!

YOU'RE A RADIO MAN!

Have you ever noticed the number of people who say, "Ah, you're a radio man.

"Now, my set crackles sometimes and even stops altogether and won't go until I bump it (you know just when there's an interesting serial on). It's so annoying, and I've had it to so-and-so and he can't find out what's wrong with it, perhaps you could tell me . . ." (Pause for breath.)

During the above pause you have time to say, "Well, it could be almost anything."

But, if you leave it at this, the remark is either construed as technical ignorance on your part or a complete lack of interest in their problems, or a gentle hint that you don't give away any information for nothing.

Alternatively, one can say that it might just be a valve, but it could as easily be an intermittent open circuit in a resistor or an open or breakdown in a condenser, a faulty I.F. transformer, &c.

By this time, if you can be bothered going any farther, your questioner is nodding sagely, but with an obviously vacant look on its face.

But what the hec else can you say? However, just to prove that there are exceptions, a rather practical acquaintance dropped in a "largish" mantel set with the explanation that it seemed thick and hard to understand at times, especially after it had been on for a while. It wasn't very loud, either, and turning up the volume only made it worse.

NEW VALVE

"My friend," I said, "you'll find that the coupling condenser to the output valve is leaky and that it is allowing a certain amount of positive voltage to appear on the grid.

"This is causing the output valve to overheat, and this, in turn, is aggravating the trouble by promoting the flow of grid current.

"The incorrect bias causes distortion and greatly limits the power output. The trouble is made all the worse because the set has a large by-

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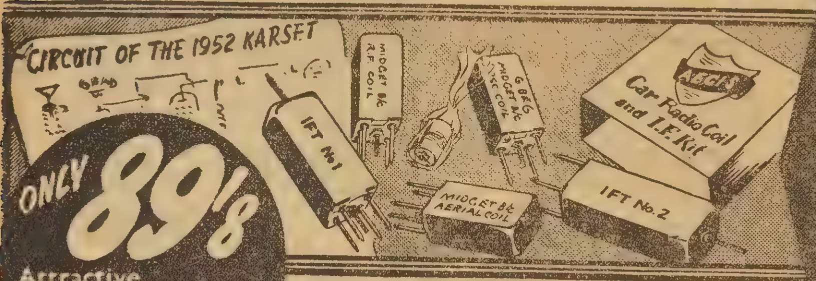

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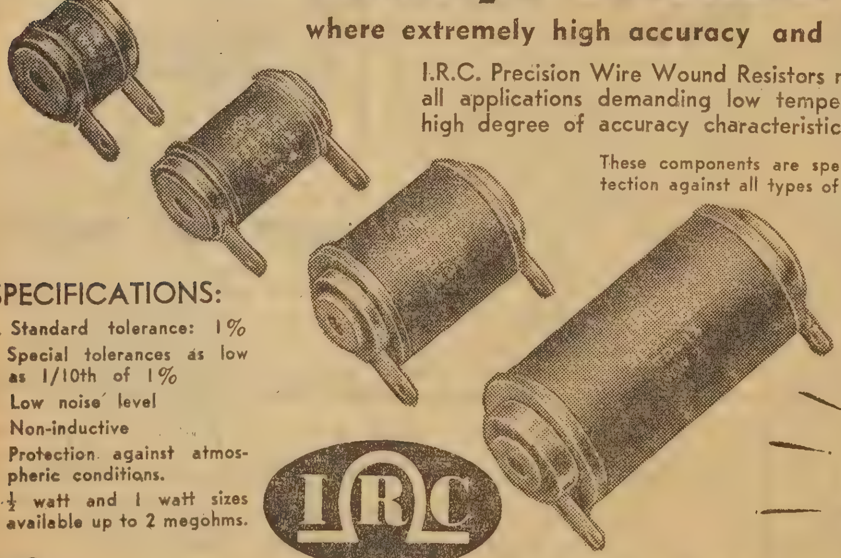

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s across the speaker which limits intelligibility, anyhow.

Your output valve has been weak- d by the abuse and should be re- ced now rather than leave it iggle on in its doubtful condition."

'hc fellow looked at me in sheer azement but the diagnosis wasn't lly so clever. You see, it was just intelligent guess based on an exact etition of the case I described at gth last month. It could have n something else.

But it wasn't. My guess was right the mark, even to the weakened put valve!

By way of conclusion, may I make remark that radio sets, like a tain famous animal, are some- es given to spitting. Leastwise, t's the term most frequently em- yed to describe the spluttering l sparking which precedes a com- ete insulation breakdown.

An old 5-valve TRF came to hand ently which exhibited trouble of s nature somewhere around the tifier. The owner had already ed to trace the short without suc- s, and only as a last resort was I led in.

RNING SMELLS

For a while I couldn't see anything her. The set would run for a ile, then splutter violently, only carry on again as if nothing had ppened. No smoke, no charring, st a faint smell of ozone and burn- g insulation.

I had a good look around the ckets, poked on the various wires d so on, but the set continued on erratic way without even notic- g my attentions.

Perhaps it was the rectifier valve, t no . . . the base was as clean d shiny as it had been when the ner wiped it over. In fact, with e rectifier out of the socket alto- ther, I could still hear an occa- nal sizzle or spark.

Then I noticed a very slight black- ing on one edge of the 80 plate- n hole. And, to be sure, that's here the sparking was. The rest as clear to my practised eye hem)!

Whoever had built the set many ars before had apparently wanted make quite sure of all the joints. erefore, he had applied a gener- s amount of flux to the plate lead nnection, possibly taking care to ipe away the excess. I'm not sure this, of course, but there wasn't y flux to be seen on the surface.

LUX CORROSION

What had happened, however, was at some of the excess flux had run between the two layers of bake- te forming the wafer socket and ere it had stayed for twenty odd ars. Now, at long last, it had de- mposed or corroded its surround- gs sufficiently to form a conduct- g path between the said plate pin d the socket mounting rivet.

This much I guessed, and the me was revealed when the socket as finally removed and opened for spection.

But why did designers, in those ays, insist on mounting huge re- stor strips directly below the line sockets? It's one of the things at cause radio servicemen to patro- ise the local tavern!

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12 x 8	4/10	6/6
14 x 8	5/9	7/7
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16 x 12	9/9	13/0
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24 x 12	14/7	19/6

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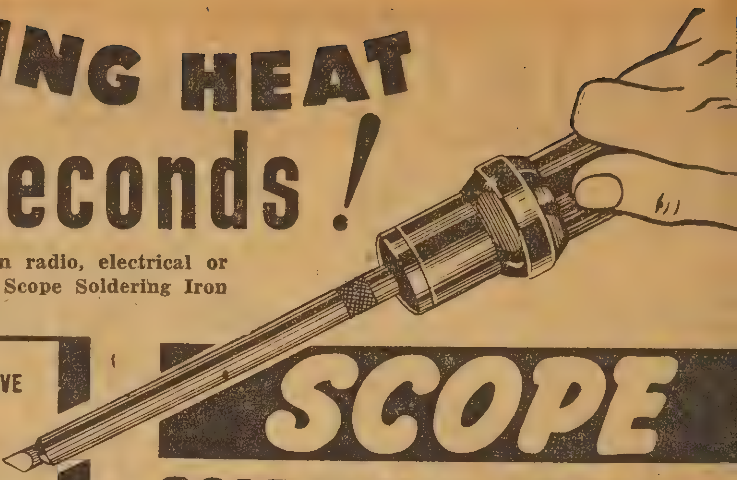

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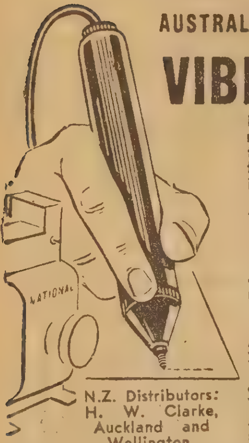

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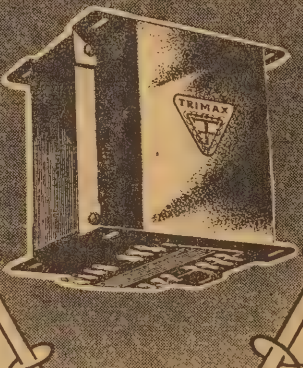

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TRADE REVIEWS AND RELEASES

DUAL 3-SPEED PLAYING DECK FROM FRED A. FALK

During the month Radio and Hobbies received for inspection a 3-speed "Dual" record player chassis No. 270. It is a companion product to the better known Dual 3-speed record changer.

Top view of the new model 270 playing deck. The metalwork is fawn, turntable deep brown and the pickup with control knob is ivory plastic.

IE player deck comes as a complete unit comprising motor and ntable, with speed control, dual-pose crystal pickup and three-ition filter giving a degree of con-l over the pickup's frequency ponse.

The speed control is a single knurl- knob on the panel which is so erconnected with the mechanism t the idler wheels beneath the ntable are withdrawn from con-t with it when the unit is not in e, preventing the formation of its" in the tyre.

Another unique feature is the pro-ion of a mercury switch to serve an automatic cut-out, avoiding the kiness of most mechanical itches.

The pickup is a crystal, for which wide response range is claimed. It has alternative sapphires for standard and microgroove records and plays with an approximate weight of nine grams.

Retail price currently quoted is £19/18/6. Supplies are available through trade houses. Information from Fred A. Falk and Co., PO Box 34, Rockdale, NSW.

MANLEY "EASI-FONE" FREES HANDS

The familiar problem of trying to handle documents &c., while speaking on the phone, is overcome by the new Manley "Easi-Fone," released by the Amplion Company.

S shown in the photograph the "Easi-Fone" provides a base on hich a standard desk telephone sits, eing locked in position by three ubber-covered pillars.

A structure behind the phone car-es a switch arm which engages the ormal switch in the top of the hone. The switch arm operates uite freely, however, and does not nterfere with normal use of the andset, should this be desired.

However, the handset can be slip-ed into position on the end of the xtension arm.

To receive a call the ear is merely placed against the handset and a slight side-pressure will release the phone switch into the talk position.

The manufacturers stress that no tools are required to fit the "Easi-Fone," nor are any changes necessary to the telephone itself.

Further information may be obtained from Amplion (A'sia) Pty. Ltd., 36-40 Parramatta Rd., Camperdown, NSW.

NEW DIRECTOR FOR MAGNAVOX

MESSRS. MAGNAVOX (Aust.) Pty. Ltd., of 51-61 Dowling St., East Sydney, have advised that Mr. R. D. Charlesworth has been appointed to the Board of the Company.

Mr. Charlesworth, who has been responsible for the design and development of Magnavox speakers in this country, will coincidentally act as Chief Engineer of the Company and Technical Director.

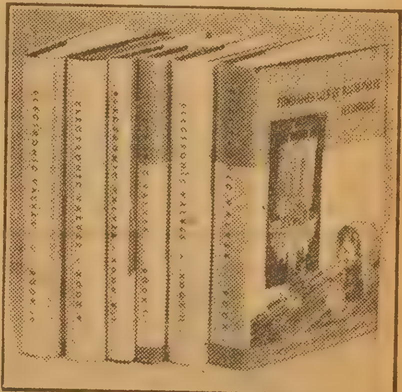
BOOK REVIEW

MESSRS. Philips Electrical Industries, have brought to our notice the fact that they have available an interesting range of technical books which are obtainable from any of their branches or by arrangement with technical booksellers.

One range of books covers lighting and subjects allied thereto, another deals with general electronic subjects, while a third series is devoted to radio valves. Five of the seven books on this last-named subject are shown.

Book 1, which retails for £2/10/6, is a broad introduction to radio valves and their application in the design of receivers and amplifiers. Mathematical support for the text is included where called for.

Book 2 contains data on the Philips range of valves produced during the years 1933-1939, together with typical circuits and design practices for receivers and other items of equipment produced during that period.



Successive books cover the periods 1940-1, also 1945-9. Book 7 (not shown) is devoted to transmitting valves. Further information from Philips Electrical Industries Aust. Pty. Ltd., 69-73 Clarence St., Sydney.

A FREQUENCY METER FOR U.H.F.

The release overseas of frequencies for UHF television and the citizens radio service has focused attention on equipment for the 300-1000 Mc region. This paper from Aerovox Corporation describes an absorption frequency meter which should be particularly interesting to prospective workers in this region.

ALTHOUGH the industry has foreseen the expansion into this region for a considerable period of time, simple test equipment for use at these frequencies has been noticeably lacking.

For this reason, the TV technician, experimenter, and radio amateur working at frequencies between 300 and 1000 megacycles per second may find himself in the position of having to construct much of his own test equipment.

Special techniques will be required since this range is the clumsy "transition region" between the more familiar VHF practices and the "plumbing - and - hardware" techniques of the microwaves.

This article, as well as several which will follow from time to time under this series, is intended to provide a useful service to its readers in this respect by describing simple basic equipment which will be needed for servicing UHF television and performing experimental work at the lower UHF range.

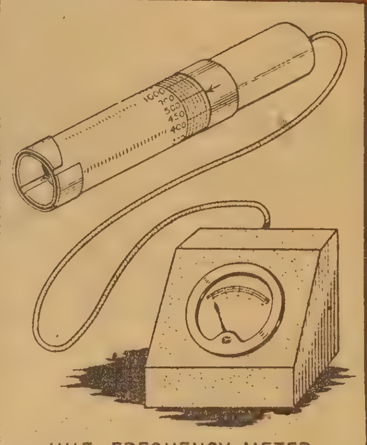
SIMPLEST DEVICE

The experimental UHF absorption meter described here can be constructed without special tools and represents the most simple device available for determining the frequency of UHF signal sources. It appears as shown in Fig. 1.

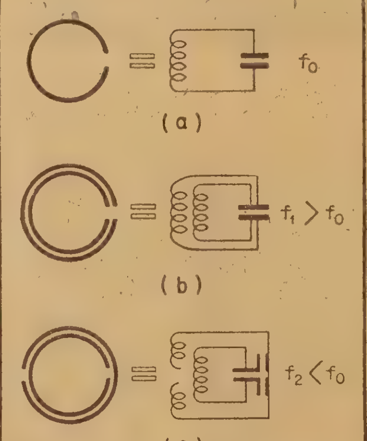
Anyone who has used an absorption meter at low frequencies is familiar with the utility of such a device for rough frequency determination.

As used for low frequency applications, it usually consists of a parallel L-C circuit capable of tuning over a wide range and calibrated in terms of resonant frequency or wave-length.

It is used to determine the unknown frequency of a signal source by loosely coupling it to the output of the signal source and noting the effect on the latter as the frequency meter is tuned to the unknown frequency.



UHF FREQUENCY METER
FIG. 1



REPRESENTATION OF SPLIT-CYLINDER TUNING
FIG. 3

This effect may be either an i
crease in the plate current or a d
crease in the grid current of t
source oscillator as the frequen
meter is tuned to resonance. Th
interaction is caused by the increa
ed loading effect produced by t
energy absorption of the resona
circuit.

The absorption meter may also
made self-indicating by coupling
indicator, such as a small incande
cent bulb or a crystal rectifier-met
combination, to it. An absorpti
meter is usually used for rough fr
quency "search" work.

CHARACTERISTICS

For use in the presently expan
ing portion of the UHF spectrum,
absorption meter should have t
following characteristics:

(a) Tune from about 300 to
least 1000 megacycles.

(b) Self-indicating for use wi
non-metered local oscillators, &c.

(c) Compact form factor to perm
use in restricted space.

(d) Rugged construction for go
frequency stability.

(e) High "Q" for sharp resonan
indication.

For our present purpose the fr
quency meter should also be ea
to construct and calibrate.

A survey of the types of tun
circuits available for UHF use in
cates that several, such as the bu
terfly, the semi-butterfly, and t
split-cylinder tuners, which are
lustrated in Fig. 2, fulfil most
these requirements.

In the form described in this issu
the split cylinder tuner has the ad
ed advantage of being the most eas
constructed. For this reason it w
chosen as the basis for our prese
design.

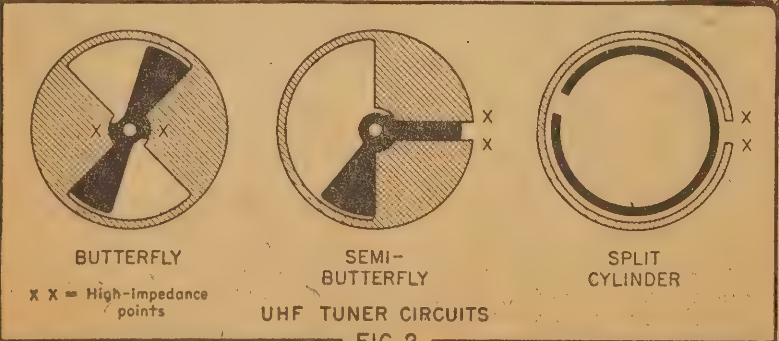
BASIC PRINCIPLE

The split cylinder tuner, attribut
to Karplus 1, is one of the types
UHF resonant circuit which is pro
ing popular for use in UHF telev
sion converters. It consists of tw
cylindrical metal tubes mounted co
centrically so that one is free to r
tate within the other.

Both tubes are split lengthw
and have diameters such that t
spacing between them is only
few thousandths of an inch. T
manner in which wide range tu
ing is accomplished with this com
bination is shown in Fig. 3.

The equivalence is one of the sp
cylinders to a conventional L
resonant circuit is illustrated in F
3a. The gap corresponds to the ca
acitance while the solid portion o
posite it is equivalent to a one-tu
inductance.

In 3b the effect of placing a simil
ring close around the first, with t



UHF TUNER CIRCUITS
FIG. 2

ap in the same position, is shown. n this position, the resonant frequency of the combination is maximum, since the inductances of the wo rings are essentially in parallel, vhile the total capacitance is not apreciably changed.

When the outside ring is rotated 80 degrees, as in Fig. 3c, the effectve capacitance of the resonant ciruit is greatly increased by the resence of the inner ring across the ap of the outer one, which has the ffect of a split-stator condenser.

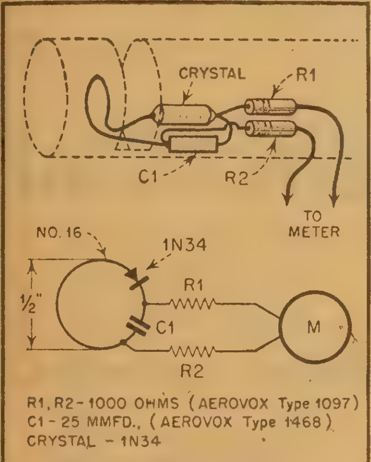
MAXIMUM INDUCTANCE

The inductance of the tuned ciruit is also maximum in this position, ince the split portion of the inner ylinder adjacent to the inductive portion of the outer one has little effect. Thus, the resonant frequency of the combination is at a minimum when the rings are in this position.

Therefore an appreciable tuning range is covered by 180-degree rotation of the movable cylinder. For simple split-cylinders, however, the tuning is not linear with rotation, but becomes very rapid at the high frequency end of the range where the movable cylinder first crosses the gap of the fixed one.

As usually employed for UHF television, the split cylinder tuner is constructed with the outer cylinder fixed in a housing and the inner ring free to rotate within it on a tuning shaft supported on bearings mounted in the ends of the housing.

The close spacing between the two must be maintained accurately, requiring considerable precision machine work.


CRYSTAL
R1
C1
R2
TO METER
NO. 16
1N34
1/2"
R1
C1
M
R2
R1, R2 - 1000 OHMS (AEROVOX Type 1097)
C1 - 25 MMFD., (AEROVOX Type 1468)
CRYSTAL - 1N34

METER INDICATOR DETAILS

FIG.6

The construction of the absorption frequency meter described here is a modified version of this tuner, suggested by Krumpfer. In this form it is easier to construct and has a form factor well adapted to this application, as shown in Fig. 1.

It is made by providing the tuner with a handle consisting of an extension of the inner split cylinder and attached to it only by a narrow section of the brass tube from which both are made.

The outer ring is separated from the inner one by a dielectric tube which fits snugly over the inner ring and tubular handle and acts to space the two split cylinders. Tuning is then accomplished by rotating the dielectric tube around the metal tube.

A TYPICAL CALIBRATION CURVE

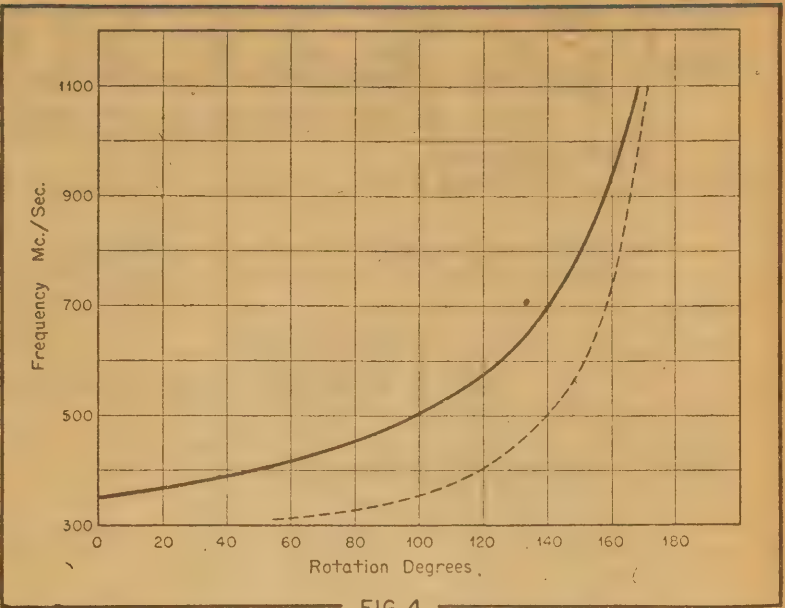


FIG.4

Means are provided to assure axial alignment of the two split cylinders and a graduated scale is marked on the dielectric tube for calibration of the frequency meter. The tuning range lies about 350 to 1100 megacycles.

To avoid the rapid variations of frequency with rotation at the high end, the outer cylinder has been shaped so that the variation of the capacitance across the gap of the inner ring is not so rapid as is the case when the tuning ring is left full width. The resulting tuning curve is shown in solid lines in Fig. 4, while the uncorrected curve is shown in dotted lines.

By further shaping of both cylinders, the tuning could probably be made essentially linear, but at some sacrifice in total coverage.

The dimensions of the frequency meter parts are shown in Fig. 5, which represents the metal tubular parts spread flat.

The body of the frequency meter and the inside cylinder are made from a single piece of standard brass tubing 1in in diameter with a .030in wall. The overall length of the brass tube is 5in.

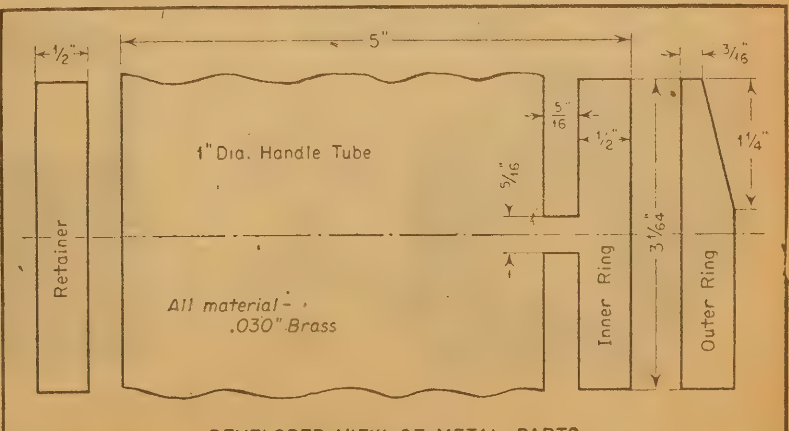
The inside resonating ring is ½in wide and is separated from the rest of the handle tube by a 5/16in gap, except where it is joined to it by a portion of the brass wall 5/16in wide diametrically opposite the slot, which is 1/8in wide. These cuts in the brass tube can be made with a hack-saw, after which the edges are dressed smooth with a file.

RETAINING COLLAR

A retaining collar of brass sheet stock or tubing is sweated around the end of the handle tube opposite the split ring to provide a stop for the dielectric tube. This collar may be scribed with an indexing mark for calibration of the frequency meter.

The outside tuning ring may be made from a piece of .030in flat brass stock bent into a split tube with a 1/8in gap, or it may be fabricated from a slightly larger size of tubing and formed to fit well

(Continued on page 89)



DEVELOPED VIEW OF METAL PARTS

FIG.5

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Electronics

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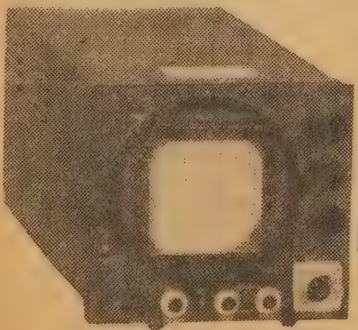
INDICATOR UNITS



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Circuit Supplied with each Unit.

If you have read each article carefully and built the sets as described, you will have built up quite a useful store of information. You will have become familiar with a good many of the parts used in present-day radio sets and accumulated a working vocabulary of technical terms.

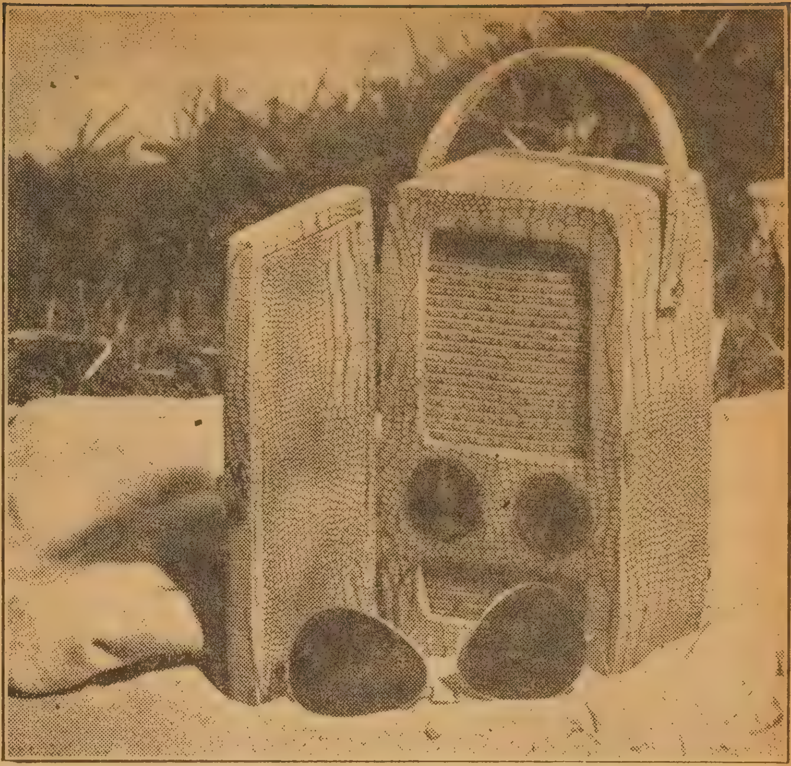
More important, however, you will probably have worked up a burning desire to do something more about it. There are lots of things still puzzling you. In looking through Radio and Hobbies, and other technical publications, you have probably seen many designs you would like to try for yourself.

Some of them may look quite simple on the surface but perhaps you need more experience before you can tackle them. The parts are expensive. You can't take the risk of wasting them.

TOO AMBITIOUS

We wouldn't recommend, for example, that you try to make a double conversion communications receiver if the only experience you have had is in making half a dozen simple sets.

But there are plenty of designs that you can tackle with a good chance of turning out a first-quality job. We have picked out three designs which met the approval of Radio and Hobbies readers, and, depending on your particular interests, you may like to try one or more of them.



The "Carry Set" looks right at home in a beach environment. Its performance is out of proportion to its small size. Compare it with the sunglasses.

Teach Yourself Radio (8)

WHERE TO GO FROM HERE?

Let's say you've followed this series right from the first introductory article in the August, 1952, issue and finished by building the three-valve set described in the February issue, or the portable described in March. What would you like to do now? This article contains some helpful and interesting suggestions.

Before getting on to the actual constructional work, there are probably quite a few questions you would like to have answered. For example, if you decide to build the "Playmaster Baby" amplifier, you will want to know how a phonograph pickup works; yet the principle of a superheterodyne receiver, should you decide to make the "Little General."

The logical place to find all this information is in the various literature which has been published on the subject. Radio and Hobbies will provide some of what you want but there is no guarantee that the information you require will be in a particular issue.

Probably the best idea is to go to one of the technical booksellers and ask to look through his selection of books on radio suitable for beginners. There have been many excellent books published over the years but they seem to go out of print and then reappear in a somewhat random fashion. However, if you look carefully, you should be able to find one to suit your need.

Recently we took the opportunity to wander through the technical book department of a well-known Sydney bookseller. We couldn't recommend any one book as ideal but a number had valuable features.

For those who don't have any backgrounds of maths or physics, Understanding Radio, by Watson, Welch and Eby, and published by the McGraw Hill Book Co., may be worth considering.

by Maurice Findlay

It starts by explaining about radio waves, magnetism and electricity, and goes on to talk about simple receiving sets. Later on there are chapters on superheterodyne receivers and other things you are likely to meet.

Although there aren't a great many diagrams, the text is written in a way that conveys the maximum of information with a minimum of effort on the part of the reader. Unfortunately, it is expensive at approx. 53/-, and there is only a limited number of copies due to dollar restrictions.

Wireless Fundamentals, by E. Armitage, and of British origin, is a more academic treatment of the subject, and, while it is an excellent book of its type, some knowledge of mathematics is necessary in order

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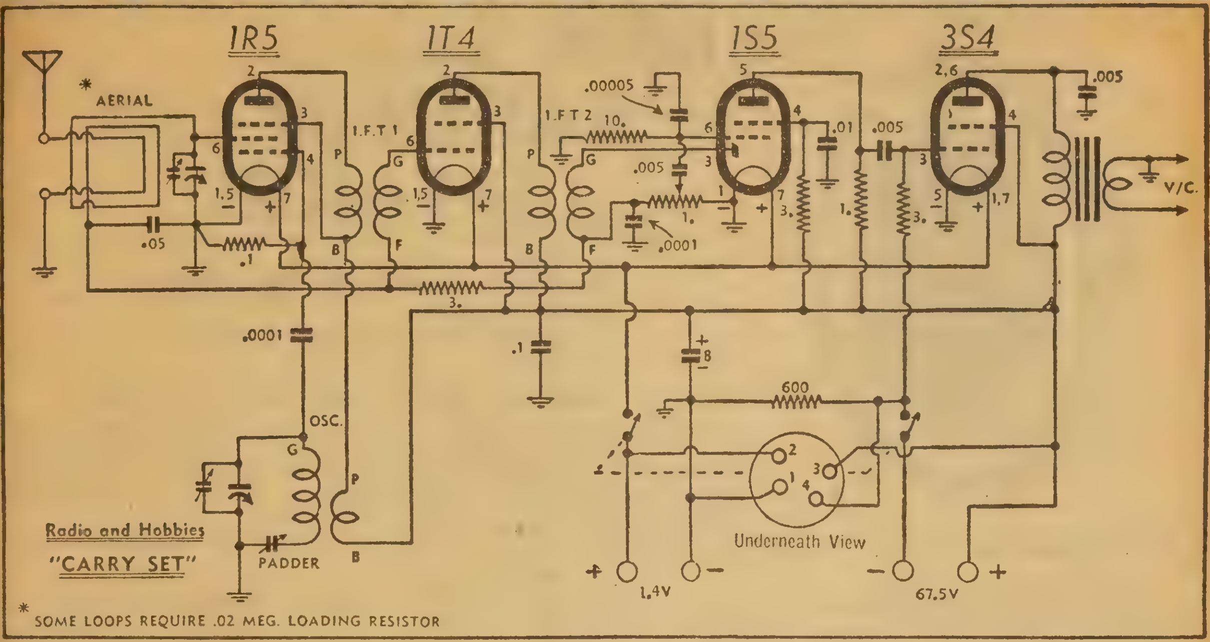
1R5
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67.5V
Radio and Hobbies
"CARRY SET"
* SOME LOOPS REQUIRE .02 MEG. LOADING RESISTOR

The "Carry Set" is an example of an excellent 4 valve personal portable receiver. Many of the components used in previous "Teach Yourself Radio" articles may be used.

to get the full value of the book. It is priced at 27/-.

Also of British origin are Everyman's Wireless Book and Practical Wireless Service Manual, both by F. J. Camm. The former is priced at 21/- and the latter at 14/6.

Everyman's Wireless Book contains plenty of well-drawn diagrams and information on important fundamental work, such as soldering. Both books have a definite British slant and feature components which will be unfamiliar to most. This is not an insuperable objection, because the principles are the same the world over.

All the books we have mentioned so fare are useful for general background reading. Their primary aim is not to tell you how to put a number of parts together and build a radio set.

TYPICAL BOOK

However, one such book is published by the Popular Science Publishing Co. Inc., under the title "How to Build 78 Radio and Television Receivers." This book has a very decided American slant and in some cases the components mentioned will not be available here. The price is 21/-.

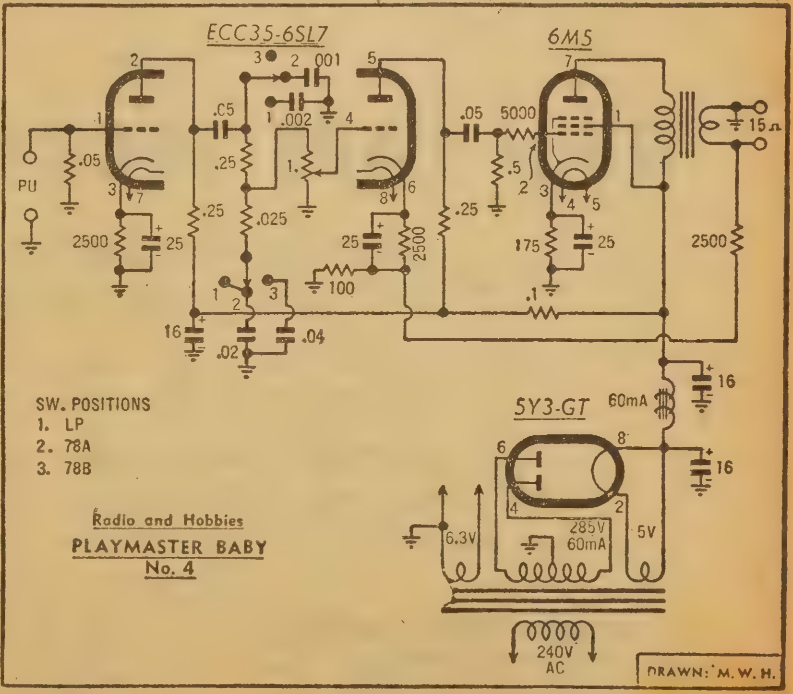
In quite a different class are the A.R.R.L. Handbook, published by the American Radio Relay League and the Radio Handbook published by Editors and Engineers Inc. The former is priced at about 45/- and the latter at about 70/-. They are designed mainly for those interested in amateur radio communication and include information on transmitting and receiving equipment suitable for amateur work.

If you've just stared off you may find the style too concise. However, they are well worth remembering if you have a chance to look at them in a library.

Finally, a valve data book is a worthwhile acquisition. The preliminary information on valves in general is well worthwhile, in addition to the particular data on valves you are likely to meet. Anything from 5/- to 10/- will buy an excellent valve data book. Write to one of the well-known valve companies.

Returning to the constructional angle, possibly you will want to use as many of the parts you already have toward a more advanced receiver. About the most suitable set for this approach is the "Carry Set," which was described in the October and a slightly different version in the November, 1949, issues. It is self-contained with a built-in loop aerial and battery supply.

Four valves are required in all, but two of these are valves which were used in the earlier sets in the series. The 67.5 volt battery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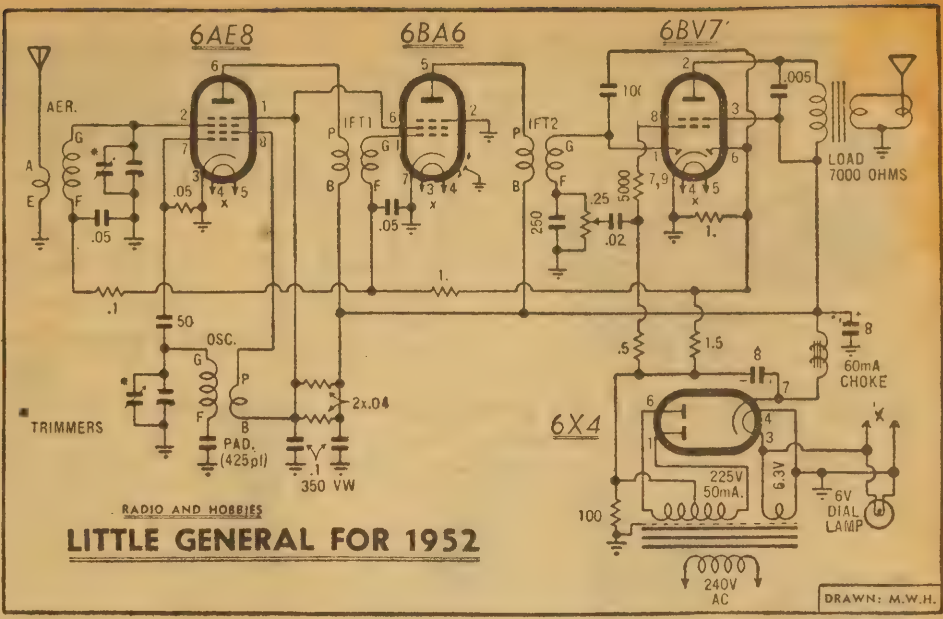
The 1952 "Little General" is the latest of a type of AC operated mantel receiver which has been popular for many years. With the latest valve types, as above, it has plenty of "pep". The under-chassis layout is clean and straightforward, being arranged especially to aid the home constructor. Circuit and wiring diagrams, parts list and under-chassis photographs are available through the 2/- Query Service. Ready-made cabinet and chassis are standard items with radio dealers.



LITTLE GENERAL FOR 1952

nay also be used provided you have ot already exhausted it in the experiments with the other sets. The niniature 2-gang condenser used for ast month's simple portable may lso be used with this set, together vith several small components.

The schematic circuit is published here, but we can supply another copy together with a wiring diagram and some pictures of the set through the 2/- query service. If you proceed carefully and take the trouble to understand how the set works there is every reason why you should be able to make a successful job of it.

NOT MUCH SPACE

The assembly and wiring is rendered more difficult than for other receivers discussed in this series because a relatively large number of parts have to be installed in a small space in order to achieve the small size.

Install each component carefully and deliberately making sure that every solder joint is perfect. There is nothing more annoying than having to undo a number of components in order to remake a faulty joint somewhere down near the bottom of the chassis.

There are adjusting screws on both top and bottom of the IF transformers, so leave sufficient room to get an alignment tool down to them.

This matter of making the various adjustments to a superhet receiver or "alignment," as it is called, is one of the things you will have to gain some knowledge of before progressing very far. You will be able to read about superhets in books and, for the practical details of the alignment procedure, we can supply a pamphlet through the query service.

Some readers will have been attracted to the "Teach Yourself Radio" series because the sets described offered a chance to gain experience without involving any risk with the power mains. Having gained that experience they will be keen to go ahead and make a regular AC operated receiver.

For such people we could do no better than to recommend the "Little General for 1952," which was described in the September issue of that year. It uses the very latest valve types and other components and gives tip-top performance without being too difficult to assemble and adjust.

There is a lot to be said, as a matter of fact, for the construction of a set like the "Little General." It fits perfectly into the role of a "second set" around the house and common experience is to find it working harder than the much more expensive console in the living-room.

The lady of the house soon learns to carry it into kitchen and bedroom, as the occasion demands, and the few pounds spent for parts are soon overshadowed by the fact that husband built it "all himself."

If you go to the trouble of making the cabinet yourself, it is so much to the good. One constructor we heard from recently worked his initials into the speaker fret and gave the cabinet a most impressive overall finish with a colorful flock spray. However, you don't have to be a genius with carpenter's tools. Ready-made cabinets can be bought specially for the set.

As with the "Carry Set" wiring diagrams and pictures are available through the query service, and you can buy the chassis and cabinet for the set from all the usual radio shops.

By the way, don't write and ask us for the complete issue containing the descriptive article. It is rarely that we have back copies outdated by more than a couple of months. If you can't manage otherwise, try to find someone who is willing to lend you the required copy or ask the advice of a friend who is better versed in these matters.

So much for "The Little General" or any other small set to which you may be attracted. There yet remains another field for endeavor—and one which is very popular with our readers. We refer to the construction of amplifiers for record playing.

With lots of new records, pickups and speakers available these days a good many readers will be keen to build a good quality amplifier to go with them. For those who want the best quality without spending a fortune and without becoming involved in complicated circuitry, we would recommend the "Playmaster Baby No. 4" amplifier, which was described in the December, 1951, issue of Radio and Hobbies.

It has sufficient gain and the necessary compensation for any of the high quality magnetic pickups. Actually, the switch positions adjust the frequency response of the amplifier to provide the correct compensation for either the British or American standards at 78 rpm as well as the long playing microgroove recordings.

Provided it is given the necessary compensation a modern crystal pickup may also be used with the amplifier with excellent results.

One-half of a twin triode valve is used as a voltage amplifier and the tone compensating the work is included in the plate circuit. The output then feeds into the other section of the twin triode and thence into the output stage. The feedback network, which is the secret of the fine performance of the amplifier, is effective over the last two stages and includes the output transformer.

Amplifiers and record reproduction is a very wide and interesting subject and we could easily go on for pages, but you will find something of interest in practically every issue of Radio and Hobbies.

Best of luck with your future projects and we hope that you have enjoyed the series.

WHEN fitting flex or cable to set or unit, anchor the cable to the chassis with a clamp, or with a knot in the flex, to prevent strain being transmitted to the soldered connections.

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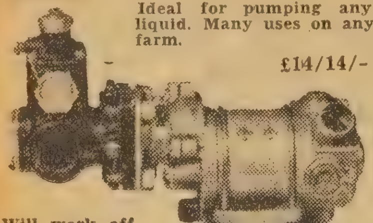

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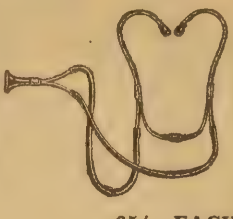

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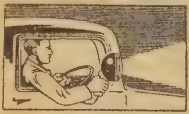

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82/6

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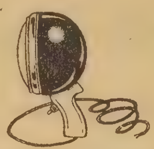

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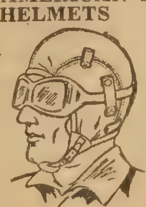

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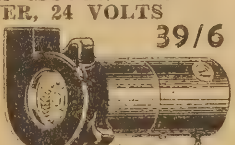

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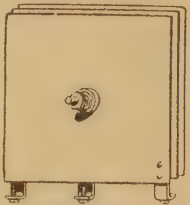

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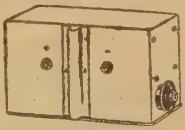

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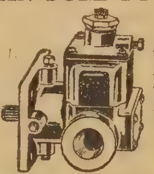

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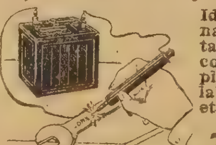

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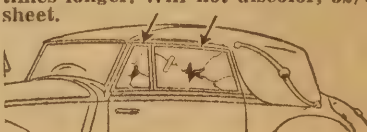

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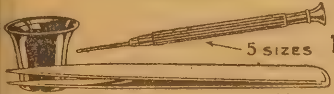

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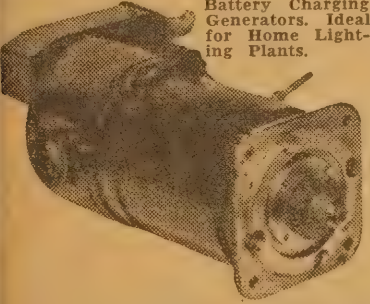

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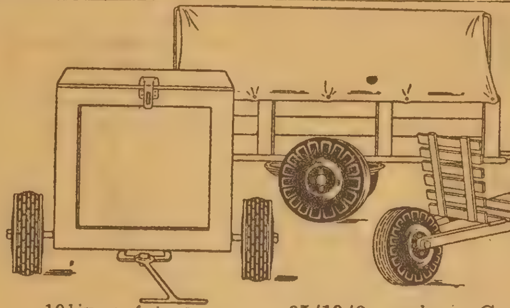

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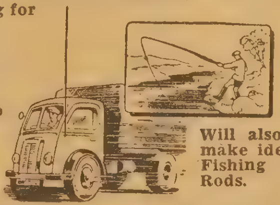

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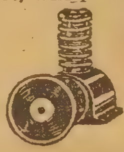

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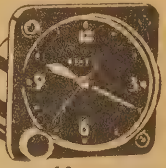

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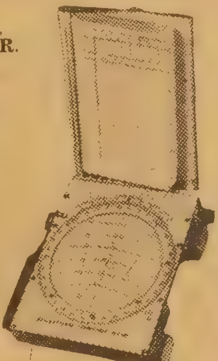

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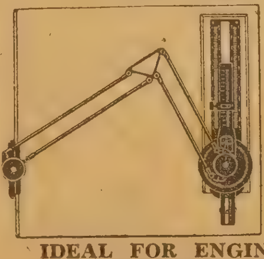

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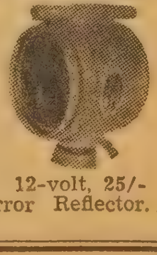

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Fitted with Mirror Reflector.

OFF THE RECORD — NEWS & REVIEWS

By JOHN MOYLE

News of the month as far as I am concerned has been a hearing of some new EMI LP records which, as I write, have just been landed. The first batch I have laid hands on are all Columbia except for a few HMV 45's, but those I have heard hold few disappointments.

AT this stage I don't know just when they will be released but it is highly probable that most will be in the shops by the time you read these notes.

The initial selection is quite an impressive one and will more than make up for the lack of serious music in recent lists. It also constitutes the reason for this lack.

EARLY FORECAST

When I heard my first LP record, with all its faults, I remarked that for me the 78 versions were as dead as the dodo. I've been hauled up for this remark more than once on various grounds, but I'm sure you'll agree on hearing these new records, even if Decca, Westminster, Nixa, Capitol and Co. haven't already converted you, that the 78's will only find a home with those who must use them, or who as yet haven't had a chance to provide themselves with the necessary gear to play the new speeds.

The re-issue of many works on microgroove will only serve to underline this fact, and among the records I shall mention here are some which you can use to demonstrate it beyond doubt.

In general, the surfaces are an advance on earlier samples, which came up with some clicks and pops with distressing regularity. There are a few to be heard on these EMI discs, but I'd like to be satisfied whether these are by accident or necessity.

All the records I have are imported, but I understand that soon we will be getting locally-pressed discs which should be of equal quality. At any rate, the EMI balloon is up in these parts, and it will be highly interesting to see how high it will rise.

Here are some impressions of those records I have played. Unfortunately, I have had only an evening or two to spend with them before the inevitable Press day, but most of the works are quite familiar to me.

SCHUMANN CONCERTO

SCHUMANN—Piano Concerto in A Minor, played by DINU LIPATTI and the PHILMARMONIC ORCHESTRA, conductor KARAJAN. Columbia 33C1001.

This is one of the recordings I have looked forward to on your behalf in its LP version, and it holds no disappointments. The new dress shows that it isn't quite as brilliant a job as I thought it might be, but it's a fine one for all that. We might argue as to the relative excellence of several performances of this work, but my impression is that Lipatti can muster up just as many credit points as anyone else, and I think I've heard most of them many times. When they are as good as this, it becomes more a personal reaction than an arbitrary one.

Once again the 78 version is left well behind in the matter of surface noise, although this wasn't particularly bad with the original. The LP record highlights the clarity of both recording and musical outline, so that I'm sure it will be accepted just as readily as I anticipated it would. Listening to it, it's hard to remember that the piano in the old days was considered to be an almost impossible instrument to record satisfactorily.

BRAHMS—Piano Quartet in G Minor, played by RUDOLPH SERKIN and members of the BUSCH QUARTET. Columbia 33CX1012.

This is a re-issue of a 78 recording, although it shows no compromise with quality because of that, as do some others. The recording is forward and vivid, balanced ar satisfying. The strings are some times not quite clean in the tc register, but this will not be notice on the average gramophone. W should remember, anyhow, that wit wide-range equipment we are a to blame a disc instead of the stylu for instance, which will show u even moderate wear in direct prc portion to the degree of extrem "top" we can reproduce. In th case, however, I think the commer is justified.

GOOD SURFACE

I don't know the work well enoug to comment too seriously on its musical standard, apart from estimatin that it has every mark of the performers with whom we are familia in much chamber music. I thin it could be bought with every confidence. The surface is quiet, an the piano comes through wit scarcely a flaw.

BEETHOVEN — Violin Concert played by EUGENE FRANCESCATTI and the PHILADELPHI ORCHESTRA, conductor ORMANDY. Columbia 33CX1011.

There are many recordings of thi concerto, but no good ones by modern standards. I'm not so happ with this disc. For a start, it exhibits the dead studio approach w often find in American recordings, and that means frequent emptiness where the scoring is light, an the impression that some of th orchestra has lost interest or gon home. Pizzicato, particularly in th bass, degenerates into rather ridiculous thumps in the absence o enough reverberation, which is quit essential to a work of this kind.

It shows up the violinist, too rather unfairly. He is a fine technician, and he knows how to handl his violin without doubt. But th remorseless mirror of the studio demands not only virtuosity but absolute perfection if uneven quality an over-obvious beat are to be avoided I can't get the impression that eithe orchestra or soloist is really insid the music—it falls down in too man places.

TOO "REMOTE"

On other aspects of the recordin I'm not so critical. You certainl won't mistake the violin for anythin else, nor will you have any troubl in hearing what is written in th score. But I don't feel it has brough me nearer to the type of performance I am looking for of this, th greatest of all violin works.

RICHARD STRAUSS—Don Jua and Till Eulenspeil, played by th PHILHARMONIC ORCHESTRA conductor HERBERT VON KARAJAN. Columbia 33CX1001.

Of the batch I'd pick this as th best technically—only a small ste from superb, a word I save for ver few. I think it's equally good musically, too, and gains immeasurabl from the complete performance without a stop. Both these works ar so integrated that breaks for disc changing wreak havoc with them Here we can relax and enjoy th

SONGSTER
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PICK-UP & PHONO NEEDLES
3 speed MOTOR
FOR STANDARD, TRANSCRIPTIONS AND MICROGROOVE RECORDINGS
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Three speeds, 33 1-3, 45, or 78 r.p.m. Full 12in Turntable. Main spindle, precision ground and lapped, runs in phosphor bronze bearings. Virtually vibrationless, synchronous motor.
New super lightweight pick-up available with interchangeable heads. Guaranteed mechanically perfect.

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raculous scoring and masterly aying as should be done.

I don’t think I’ve ever heard a ore satisfying record of “Don Juan” d “Till” is not far behind. One two spots might have been treated ith a little more significance, as, r instance, Till’s last squeal as he ces his end—a fulcrum on which ost of the tale is turned. But e essential light and shade that ashes through this kind of Strauss all there, presented with a sensitivity which seems to be one of e conductor’s hallmarks. I’d say is disc is a definite “must” from olumbia’s first list.

The surface has a few clicks here d there, but experience will probly show this characteristic to be ore attributable to individual discs an to the pressings as a whole. his comment applies, I think, as a eneral principle.

AYREUTH FESTIVAL

WAGNER—Die Walkure, Act III, ayreuth Festival recording.

It’s too much of a mouthful to nclude full details of the performers f this Wagnerian epic, particularly s we have heard it over the air n former occasions. Few of us nissed hearing at least some of it, nd of the other operas which make p the ring. Astrid Varnay as Brunnhilde and Sigurd Bjorling as Wotan re the principals.

My reaction is much the same as when I heard the first broadcast. ere is performance so good that nly much closer acquaintance plus a hearing of alternative versions ould make criticism worthwhile. In act, because until the advent of LP records, few people have ever heard the opera in anything like its entirety (including myself), I’m sure most listeners will be far too occupied with the music to be critical. Even so, I doubt whether they could find anything but admiration for these records as a whole.

They were made, of course, during an actual performance, and we are, therefore, conscious of a certain movement of the singers, and even an odd but faint noise from the audience. The orchestra, too, has more the air of an actual broadcast than a “set-up” recording session. Personally, I don’t find this in any way disturbing for it does away with any feeling of the singers merely running through the parts in a concert hall.

NEW REVELATION

The entire musical balance, the standard of singing, the general air of conviction without which Wagner can sound verbose and dreary are all worthy of special mention. Once again I say that records such as these, and there will be more of them, will without doubt bring a new world to record buyers. The enormous popularity of operatic sets all over the world is I’m sure due to this fact.

The surfaces of the records I heard were first class, noise being inaudible almost throughout, using the full range of the equipment.

MOZART — Symphony No. 41 (Jupiter), played by the ROYAL PHILHARMONIC ORCHESTRA, conducted by SIR THOMAS BEECHAM.

This is a typical 78 type performance except that the movements are uninterrupted, and there is negligible surface noise. By that I mean it is not a wide-range recording as we know it by the best LP standards, but this will probably not be so noticeable except on the best equipment. Most of us know now how Beecham handles Mozart. His performance here is, therefore, just what one would expect. It is reasonably clean throughout and is at least the equal of any performance available to date.

45 RPM DISCS

A couple of the 7-inch 45’s by HMV come next. The first is SAINT-SAENS’ Introduction and Rondo Capriccio played by HEIFETZ and the VICTOR SYMPHONY ORCHESTRA 7R133. This appears a straight redub of a popular 78, 12-inch record, and except that the surface is quiet, is much the same as the original. It might even be a little less bright due to some filtering to reduce the surface-noise even further, and it doesn’t compare with the brilliance of later records. On the other hand I doubt whether it was meant to. It is an interesting example of how this type of record can supersede the 78-type without serious loss and with many advantages in size and quiet playing.

In STRAUSS’ Dance of the Seven Veils, played by the ROYAL PHILHARMONIC ORCHESTRA, conductor BEECHAM, 7R103, we have, I think, another example of a 78 redub using a technically much

(Continued on Page 95)

Dual FA

3-Speed Recordplayer Chassis No. 270

for normal and long playing records

The pick-up arm is moulded in plexigum, free from self-resonance. The pick-up system is a high-grade crystal with two sapphires for normal and microgroove records. Either of the two needles can be selected by means of a rocker system in front of the head. The whole head can be easily removed from the tone arm. The range of reproduction is 30 to 14,000 cycles, the needle-pressure 9 grs. The twin sapphire assembly as well as the crystal cartridge are easily replaceable.

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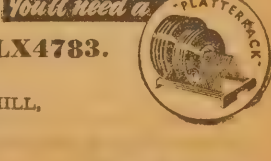

SHORT-WAVE NOTES BY ART CUSHEN

"VOICE OF THE FIJI ISLANDS"

Extensive tests have been carried out by a new short-wave transmitter at Suva, Fiji over the past month, when frequencies in the 49, 41 and 31 metre band have been used.

In early February the first tests were conducted on 6005kcs, then the 5995kcs frequency and 6130kcs channel were tested, the station operating on each frequency for a week. After a test on 7195kcs, the station is being heard, as we go to press, on 9535kcs.

This new transmitter, which relays the new 2000w broadcast band station ZJV's commercial programs, operates 3.30 to 8.00 pm daily. Regular features include BBC news relay at 4.00 pm, and ABC news at 7 pm. Sign on at 3.30 pm, Sunday is followed with the program "Bringing Christ to the Nations."

Readers may remember the earlier broadcasts from Suva, when they operated station VPD2 using the power of 400 watts. During late 1941, the station, operated by the Amalgamated Wireless, tested on three frequencies, 9535, 11,895 and 15,160kcs, and as well, carried the regular program on 6130kcs.

In a letter from the station, during that period of experimental broadcasts, the station was to increase power to 10,000 watts. Due to the Pacific War, the proposal was dropped, but during 1943 the 400 watt transmitter was used for a period on 6130kcs in order to give the many Forces listeners scattered throughout the Fiji Island a better signal.

The new transmitter, widely reported throughout the world, will be welcomed by many new listeners, and means another country to verify.

The station is asking for reports, to be sent to the Postmaster General, Suva. They are very interested to know the comparison in signal strength, interference, &c. between the frequencies they have been testing on, and listeners suggestions as to the best frequency to be used, would be welcomed by the station.

NEW TIME STATION

The month's most interesting station is ZYZ20 "Radio Relegio Federal" Rio de Janiero, Brazil, operated on 4905kcs, 24 hours a day.

This station, projected some months ago, can be heard at good strength around 7 pm with announcements in Portuguese. Each minute a chime is sounded, with alternate commercial and station identification each minute. ZYZ20 operates with 5000w, and has a broadcast band outlet on 1490kcs, with 1000w. The entertainment value of this station to the local listener must be very limited, as the complete transmission for the 24 hours is all announcements.

INDONESIA STRONG TO AUSTRALIA

Radio Indonesia, PO Box 7, Djakarta, has deleted the transmission on YDC (15150) and replaced by the new 50,000w transmitter on 9710kcs.

The new transmitter was tested on 9865kcs, and now is in service with the complete overseas service from 9.00 pm to sign off at 6.00 am. The English broadcasts are heard at 9 pm, 12.45 and 5.00 am, beamed to Australia-New Zealand, Asia and Europe-New Zealand respectively. Reports are requested to PO Box, 7 Djakarta, Java. The transmission at 9.00 pm is also carried on the 60 metre band frequency of 4910kcs, station YDB2.

INDIA — As well as the European service to Turkey, 5.30-6.15 am and United Kingdom 6.15-7.00 am broadcast by All India Radio, Delhi, a new transmission for morning reception in Europe has been heard from 5.30-6.30 pm on 15160 and 17705kcs.

DIGEST OF LATEST DX TIPS

Kcs	Call and Location	Time Heard.
4825	Radio Malaya, Singapore.	Sign off 2.00 am Sunday.
4870	Radio Ceylon, Colombo.	Commercial Service to 2.45 am.
4905	ZYZ20, Rio de Janiero, Brazil.	Time announcements 6.00 pm.
4960	Delhi, India.	To Europe, French to 6.30 am.
6450	COCY, Havana, Cuba.	English request session 4.30 pm.
7180	JOB2, Tokio, Japan.	English news 9.00 pm.
9535	Suva, Fiji.	Test 3.30—8.00 pm.
11945	Djakarta, Indonesia.	English-Indonesian lessons 8.45 pm Mon.

BELGIAN CONGO. — A prize verification received by Jack Corbett, Brisbane, is from OQ2AC, Radio College, PO Box 296, Elizabethville. This station operates 5.00-7.00 pm, 2.30-3.30 am on 2390, 4980 and 7200kcs, all transmitters operating with 250 watts. Programs are in Portuguese but a short English announcement is given when closing by one of the school boys.

VENEZUELA. — YVMW "Ondas del Caribe" 4770kcs, located at Punto Fijo, Venezuela, verifies with a card showing the modern studio buildings, which is signed by the Director, Sen. Luis Manuel Gonzalez.

NOTES for the next issue should be sent to Arthur Cushen, 212 Earn St., Invercargill, New Zealand. All times are Eastern Australian Time. Closing date for notes for the May issue is April 5th and June issue, May 10th

SHORT-WAVE AERIALS

One of the questions most frequently posed by potential short-wave listeners is whether a special aerial system is necessary as, for example, those used by amateurs.

The standard answer is "No" and for a fairly obvious reason. Amateurs are generally interested in transmitting and receiving on one or more specified bands and their aerials are specifically designed to resonate on these bands. The fact that their characteristics may be poor elsewhere in the spectrum does not matter.

Short-wave listeners, on the other hand, are interested in a wide range of frequencies and an ordinary general-purpose aerial, 50 odd feet long and as high as practicable, will usually be all that is required. Keep the lead-in to the shortest convenient path and, for preference, use an effective earth.

At the same time, if you happen to be interested in a particular band, viz. 19 or 25 or 31 metres, it is not difficult to erect a simple dipole which will be resonant in the band of your choice. Calculations involved are simple and are covered under "Aerials" in most amateur handbooks.

FLASHES FROM EVERYWHERE

HAITI. — 4VEH, Box 1 Cap Haitian Haiti, operating on 9685kcs, is to broadcast a special transmission for oversea listeners on Easter Sunday at 2.45 pm This broadcast will consist of specia organ numbers transcribed at Morganstown, W. Va, USA, by the well-known d Editor of Radio and Television News Ken Boord.

Reports are requested from listener hearing the broadcast, and correct reports will be verified with a new verification card, but return postage in th form of an International Reply Coupo would be appreciated. 4VEH is operate by the East and West Indian Bible Mission and has been in operation for only a few years, and has found is hard to get suitable frequency in the 31 metre band to increase its coverage.

VIETNAM. — A new series of verification cards are to be sent by Radio France Asie, to listeners, when they confirm reception, according to advice received from one of our regular readers Russell J Hardidge, Doncaster West, Victoria. English broadcasts are heard at 8.30 am (9750kcs), 9.30 am (7230), 11.30 am (11935) 8.00 pm (15430), midnight (11935). We also learn that M. Jean Pipon, who has been Head of the English Department of Radio France Asie, Saigon, is to return to France in May. M. Pipon's kind co-operation with radio listeners will be very much missed.

NEWS FROM THE HOMELAND

GREECE. — This month we feature information of the reception of Greek broadcasts in this area, following an enquiry from Mr. C. Zaglay, Ashfield, NSW.

The best reception of the Athens short-wave service at present is on 7300kcs, on Sundays, when at 5.00 pm, a Church Service can be heard. This service is also relayed by several of the Greek Forces stations, the best signal being Larissa on 6745kcs. Athens operates on 7300kcs, from 1.30 to 10.35 pm, and during the winter last year, we heard a short English session at 3.00 pm.

Commentary from the United Nations Radio is heard at 3.45, Tuesday to Sunday, on 9520kcs, for relay by Radio Athens. The BBC presents news in Greek at 2 pm in 31,41 metres bands, 9.15 pm in the 25 and 19 metre bands, and 4.30 am in the 25 and 31 metre bands. Voice of America programs in Greek are radiated twice daily, 2.15 am in the 19,25 and 31 metre bands, and at 5.15 am in the same bands.

CHILIAN'S IMPROVING. — Afternoon reception in the winter can be most interesting when one has a liking for Latin American stations, and this season the Chilian stations have been noted at good strength in the 25 and 31 metre bands Some frequencies have been changed the main ones being CE1173 now on 11945kcs "Radio Sociedad Mineria" Santiago, while CE1190 formerly on 11900kcs, has moved to 11925kcs, closing just after 2.00 pm, using the slogan "Radio La Cooperativ Vitalicia" and closing with "Pomp an Circumstance" (Elgar) or better know as "Land of Hope and Glory." CE96 using 9585kcs, is very strong to after 4.0 pm, using the slogan "Radio La Americana" while the programs are dance relays from a local dance hall. The most interesting Chilian heard recently wa CEZ7C "Radio Yungay" Santiago, o 7660kcs which had a dance relay to 5.0 pm, this was during the visit of Presiden Peron to Chile, when most stations were heard with extended broadcasts.

THE HAM BANDS WITH BILL MOORE

Open for telephony transmission in many countries, the 7 Mc amateur band now includes American telephony stations within its limits. However the portion of the spectrum allotted clashes with a Short Wave Broadcast band in other parts of the world and considerable interference is being experienced.

N late February amateur radio stations in the United States and its territories eceived permission to operate telephony n the 7 Mc band within the limits of 200 to 7300 Kc.

Throughout the years many words have een written and spoken for and against he use of telephony on this band in the S. It was possibly the most vexed of egulatory questions.

Up till this year the 7 Mc band in hat country has been the exclusive hunting ground for the key-punchers.

A prewar ballot was conducted by the ARRL on the subject of 7 Mc telephony peration, and although the result was lightly in favor of such operation no ction was taken. The war intervened, nd it is only within the last few years hat any concrete action was taken.

The W's right now are battling it out with the various commercial B/C stations hat operate in that section of the spectrum. The opening day on the band was something to remember—a squealing mass of commercial and amateur stations —none of them clearly audible. During he W/VE contest the new segment was in popular use, at one stage a KC6 and a CE appeared but they were quickly blotted out.

During the contest only a few of the better signals were really readible. W6AM, W7DL and W9NDA were about the best, the latter two stations probably having available similar antenna forms to the one owned by Don W6AM.

New Zealand stations were doing well with W's on telephony, having the advantage of being closer and the extension of their 7 Mc band to 7200 Kc leaves them a fairly clear 50 Kc. The VK's mainly operating around 7150 Kc. It was evident too that many stations were running their modulators at too high a level in an endeavor to transmit readible signals to the US. 7 Mc signals are not as easily sent around the world as on 14 Mc, and the tendency to obtain the last watt out of the transmitter will have to be watched if the band is to be kept clear of broad signals.

At the same time as the telephony privileges were granted on 7 Mc, a new segment was opened for novice licencees. The new frequencies available are from 7175 to 7200 Kc and a number of WN stations have been heard up to S7.

NEW INTERNATIONAL PREFIX LIST

The ARRL's recently published list of countries for DXCC purposes covers the prefixes used since the war for most countries.

A few changes have been made in the following list in view of more recent variations in prefixes.

AC3—Sikkim, AC4—Tibet, AG2 (see 1), AP—Pakistan.

C (unofficial)—China, C3—Formosa, C9 —Manchuria, CE—Chile, CM, CO—Cuba, CN—French Morocco, CP—Bolivia, CR4—Cape Verde Islands, CR5—Portuguese Guinea, CR5—Principe, Sao Thome, CR6—Angola, CR7—Mozambique, CR8—Goa (Portuguese India), CR9—Macau, CR10—Timor, CT1—Portugal, CT2—Azores Island, CT3—Madiera Island, CX—Uruguay.

DL, DJ—Germany, DU—Philippine Islands.

EA—Spain, EA6—Balearic Islands, EA8 —Canary Islands, EA9—Spanish Morocco, EI—Eire, EK—Tangier Zone, EL—Liberia, EP, EQ—Persia, ET—Ethiopia, F—France, FA—Algeria, FB8—Amsterdam and St. Paul Islands, FB8—Kerguelen Islands, FB8—Madagascar, FC—Corsica, FD8—French Togoland, FE8—French Cameroons, FF8—French West Africa, FG8—Guadeloupe, F18—French Indo-China, FK8—New Caledonia, FKS8 (See OE), FL8—French Somaliland, FM8—Martinique, FN —French India, FO8—French Oceania, FP8—St. Pierre and Miquelon Islands, FQ8—French Equatorial Africa, FR8— Reunion Island, FU8, YJ—New Hebrides, FY8—French Equatorial Africa.

G—England, GC—Channel Islands, GD—Isle of Man, GI—Northern Ireland, GM—Scotland, GW—Wales.

HA—Hungary, HB—Switzerland, HC—Ecuador, HE—Liechtenstein, HH—Haiti, HI—Dominican Republic, HK—Colombia, HL—Korea, HP—Panama, HR—Honduras, HS—Siam, HV—Vatican City, HZ—Saudi Arabia (Hedjaz and Nejd), I—Italy, I, AG2, MF2—Trieste, 15, MD4, MS4—Italian Somaliland, 16, MD3, M13—Eritrea, IS—Sardinia, JA, KA—Japan, JA—Bonin and Volcano Islands, JY—Jordan.

K—(See W), KA—(see JA), KB6—Baker, Howland and American Phoenix Islands, KC6—Caroline Islands, KC6—Palau Is., KG4—Guantanamo Bay, KG6—Mariana Islands, KH6—Hawaiian Islands, KJ6—Johnston Is., KL7—Alaska, KM6—Midway Islands, KP4—Puerto Rico, KP6—Palmyra Group, Jarvis Is., KR6—Ryukyu Is., KS4—Swan Is., KS6—American Samoa, KV4—Virgin Is., KW6—Wake Is., KX6—Marshall Is., KZ5—Canal Zone.

LA—Norway, LA—Svalbard (Spitzbergen), LI, MCI, 2, MDI, 2, MTI, 2, 5A2, 3—Libya, LU—Argentina, LX—Luxembourg, LZ—Bulgaria.

MI—San Marino, MB9 (See OE), MCI, 2 (See LI), MDI, 2 (see LI), MD3 (see 16), MD4 (see 15), MD5 (see SU), MD6 (see YI), FM2 (see 1), MI3 (see 16), MP4 (see VU7), MP4—Kuwait, MP4—Tricial Oman, MS4 (see 15), MTI, 2 (see LI).

OA—Peru, OD—Lebanon, OE, MBG, FKS8—Austria, OH—Finland, OK — Czechoslovakia, ON—Belgium, OQ—Beligan Congo, OX—Greenland, OY—Faeroes, OZ—Denmark, PA—Netherlands, PJ—Netherlands West Indies, PKI, 2, 3—Java, PK4—Sumatra, PK5—Netherlands Borneo, PK6—Celebes and Molucca Islands, PK6, 7—Netherlands New Guinea, PX—Andorra, PY—Brazil, PZ—Netherlands Guiana.

SM—Sweden, SP—Poland, ST—Anglo-Egyptian Sudan, SU, MD5—Egypt, SV—Greece, SV—Crete, SV5—Dodecanese.

TA—Turkey, TF——Iceland, TG—Guatemala, TI—Costa Rica, TI—Cocos Island. UAI, 3, 4, 6—European Russian Socialist Federated Soviet Republic, UA9, Q—, Asiatic Russian SFSR, UB5—Ukraine, UC2 —White Russian Soviet Socialist Republic, UD6—Azerbaijan, UF6—Georgia, UG6—Armenia, UH8—Turkoman, U18—Uzbek, UJ8—Tadzhik, UL7—Kazakh, UM8—Kirghiz, UNI—Karelo-Finnish Republic, UO5—Modavia, UP2—Lithuania, UQ2—Latvia, UR2—Estonia.

VE, VO—Canada, VK—Australia, VKI —Heard Is., VKI—Macquarie Island., VK9 —Papua Territory, VK9—Territory of New Guinea, VK9—Norfolk Island, VO (see VE), VPI—British Honduras, VP2—Leeward Is., VP2—Windward Is., VP3—British Guiana, VP4—Trinidad and Tobago, VP5—Cayman Is., VP5—Jamaica, VP5—Turks and Caicos Is., VP6—Barbados, VP7—Bahama Is., VP8—Falkland Is., VP8 —South Georgia, VP8—South Orkney Is., VP8—South Sandwich Is., VP8—South Shetland Is., VP9—Bermuda Is., VQI—Zanzibar, VQ2—Northern Rhodesia, VQ3 —Tanganyika, VQ4—Kenya, VQ5—Uganda, VQ6—British Somaliland, VQ8—Chagos Is., VQ8—Mauritius, VQ9—Seychelles, VRI —Gilbert and Ellice Islands and Ocean Is., VRI—British Phoenix Islands, VR2—Fiji Is., VR3—Fanning Island (Christmas Island), VR4—Solomon Is., VR5—Tonga (Friendly) Is., VR6—Pitcairn Is., VSI—Singapore, VS2—Malaya, VS4—British North Borneo, VS5—Brunei, VS5—Sarawak, VS6—Hongkong, VS7—Ceylon, VS9 —Aden and Socotra, VS9—Maldive Is., VS9—Oman, VU—India, VU4—Laccadive Is., VU7, MP4—Bahrein Island, W, K—USA, XE—Mexico, XZ—Burma.

YA—Afghanistan, YI, MD6—Iraq, YJ (see FU8), YK—Syria, YN—Nicaragua, YO, YR—Roumania, YS—Salvador, YT, YU—Yugoslavia, YV—Venequella.

ZA—Albania, ZBI—Malta, ZB2—Gibraltar, ZC2, VKI—Cocos Islands, ZC3—Christmas Island, ZC4—Cyprus, ZC5—British North Borneo (in use), ZC6—Palestine, ZDI—Sierra Leone, ZD2—Nigeria, ZD3—Gambia, ZD4—Gold Coast, Togoland, ZD6—Nyasaland, ZD7—St. Helena, ZD8—Ascension Island, ZD9—Tristan da Cunha and Gough Is., ZE—Southern Rhodesia, ZKI—Cook Is., ZK2—Niue, ZL—New Zealand, ZM—British Samoa, ZP—Paraguay, ZSI, 2, 4, 5, 6—Union of South Africa, ZS3—South-west Africa, ZS7—Swaziland, ZS8—Basutoland, ZS9—Bechuanaland, 3AI, 1—Monaco, 3V8 —Tunisia, 4X4—Israel, 5A2, 3 (see LI), 9S4—Saar.

Countries with no regular prefixes are as follows: Aldabra Is., Andaman and Nicobar Islands, Antartica, Bhutan, Clipperton Is., Comoro Is., Easter Is., Fridtjof Nansen Land (Franz Josef Land), Jalapagos, Ifni, Jan Mayen Is., Marion Island, Mongolia, Nepal, Qatar, Rio de Oro, Spanish Guinea, Tannu Tuva, Tokelea (Union) Island, Wrangel Is., Yemen.

SPANISH CERTIFICATE

Another operating certificate recently announced is issued by the URE (Spanish National Society), Aparatado 220, Madrid, Spain.

The certificate is known as the "Espana Diploma" and applicants must show confirmation of 125 contacts with separate EA stations in Spain's nine districts, with at least three QSO's with each district.

EA9 and EAO districts count as one district. Either CW or telephony contacts will count and must be made after January 1, 1952.

A statement from the National Society verifying the contacts will be sufficient, QSL's need not be sent to the URE. The certificate may also be granted to distinguished Spanish and foreign amateurs for their work in amateur radio.

WIA — N.S.W. DIVISION

A full and comprehensive lecture, prerecorded on tape, was presented by Messrs. Tremlett, Johnson and Bourne, of Philips Electrical Industries Pty. Ltd. Their subject: 'Valve Design and Application," besides the lecture slides and a film on valve manufacture were shown. The popularity of the lecture could be gauged by the number of questions that arose from the presentation.

Section president John Miller, VK2ANF, lectured at the March meeting of the NSW UHF section. John covered fully front ends of UHF receivers with a special emphasis on the Cascode circuit. The lecture was greatly appreciated and those that have heard John's Cascode front end performing, appreciate his knowledge of the subject.

Past president Jim Corbin, VK2YC, was elected Federal councillor at the February meeting of the NSW division. Jim, who has been NSW QSL officer for over 20 years, is very well known to amateurs. Last year's councillor Vaughan Wilson, VK2VW, will attend the convention as observer for the division. The Federal convention will be held in Melbourne during Easter.

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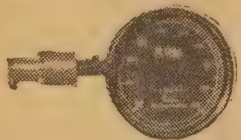

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- 1 Key Switch

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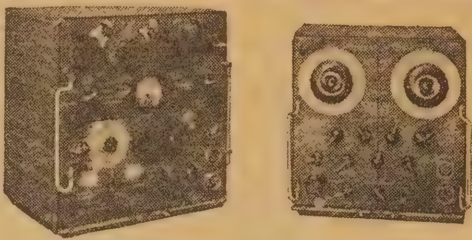

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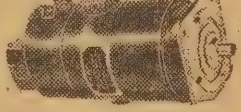
Receiver £25/0/0. Transmitter £12/10/-.

BUILD YOUR OWN ELECTRIC LIGHT AND POWER PLANT



Aircraft Generators

12v 500w brand new	£7/10/-
24v 500w brand new	£11/15/-
24v 1000w brand new	£12/15/-
24v 1000 watt brand new Bendix fitted with 3½in Double Vee Pulley	£19/15/-

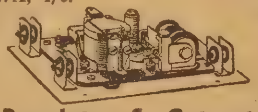
24v models can be used as 32v without alteration.

100v 600w	£15
50-0-50 Ammeter, moving coil	£2/10/-

Postage and Packing on Ammeter: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.

3½in V Pully to suit 12 and 24v models 35/-
Postage and Packing: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.

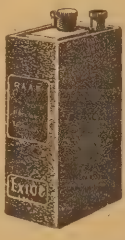
12v Cut-out 15/-
Postage and Packing: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.



Regulator & Cut-out

Suitable for use with 24v and 32v Generators, or as tractor spare. Made by Bendix of U.S.A. Price £3/10/-.
Postage and Packing: Vic., 5/-; NSW, SA, Tas., 7/-; Qld., WA, 8/6.

LEAD ACID ACCUMULATORS

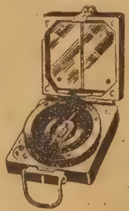


Type B. 2 volt 20 amp hours. Made by Exide. Size 7in x 3¼in x 2¼in. Weight 3½lbs.

3 for 30/-

Postage and Packing: Vic., 7/6; NSW, SA, Tas., 10/6; WA, Qld., 14/3.

HIKING COMPASS



A practical compass in a bakelite case, 2¼in x 2¼in. With thumb ring. Calibrated with luminous markings for night use. Invaluable for hikers.
Price, £1/9/6.
Postage and Packing: Vic., 4/-; NSW, SA, Tas., 5/-; Qld., WA, 5/6.

THROAT MICROPHONES

Magnetic type, high output. Can also be used as contact microphones on musical instruments. Comprises two microphone units which may be used separately. **12/6**

Postage and Packing: Vic., 4/-; NSW, SA, Tas., 5/-; Qld., WA, 5/6.

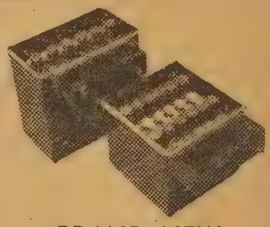
19 Volt MOTORS

Laminated field for use with AC or DC supply. Approx. 1/10 H.P. Good general purpose motor for low voltage systems.

£1/19/6

Postage and Packing: Vic., 5/-; NSW, SA, Tas., 7/-; Qld., WA, 8/6.

ALL GOODS CONSIGNED FREIGHT PAYABLE ON DELIVERY UNLESS OTHERWISE STATED.



BRAND NEW AMERICAN AIRCRAFT BATTERIES

These strongly built Batteries in metal case, made by Exide, are without a doubt a real bargain and money well spent. They are suitble for:—

- ★ HOME LIGHTING PLANTS
- ★ CARAVAN LIGHTING
- ★ YACHTS
- ★ RADIO

and many other useful purposes where a seurdy Battery is required. There are two types.

12 VOLT, 34 AMP HOURS	£3/19/6
24 VOLT, 11 AMP HOURS	£2/19/6

1 M/C CRYSTALS

Suitable for Crystal Calibrators £2/-/-
Postage and Packing: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.

BENDIX LOOP AERIAL RA. 10FA

Incorporating a rotating mechanism and 120 to 1 reduction gear with a 9 inch loop.

15/-

Postage and Packing: Vic., 6/-; SA, NSW, Tas., 8/6; Qld., WA, 11/-.

COMMAND TRANSMITTER CONTROLS

TYPE BC450

- 3 Slow Motion Dials
- 6 Single Pole Double Throw Switches
- 4 Miniature Jacks
- 3 Volume Controls, approx. 5000 Ohms.

£1-15-0

RECEIVER TYPE 301A

Containing:
2-954 5-6AC7 1-879
2-955 1-6H6 1-5V4
& 24v switching motor.

BRAND NEW

£10-0-0

CATHODE RAY INDICATORS

(AMERICAN)

Type CPR-55 ABB
Containing 5BPI CR Valve and full-length Mu-Metal Shield, 3—6H6 and 4—6AC7.

BRAND NEW

£12-10-0

he North Coast convention of the W division will be in full swing during Easter weekend. Amateurs in Aus-lia and New Zealand are invited to en out for stations operating in the ry Challender Memorial Trophy on 40 metre band on Saturday, April 4. e contest will run for two hours, from 0 to 1730 hours EAST.

tations will again be in operation on nday, April 5, in the Urunga Scramble ween 1500 and 1600 hours EAST. They 1 use any band in this latter contest. mpetition will be very keen in these itests, and your contact with stations erating from the convention venue ght decide the winner.

The NSW UHF section's demonstration esented at the February meeting of the inter branch at Newcastle proved very pular and among the 70 present were Sydney visitors.

President Lionel Swain, VK2CS, was the chair, and visitors excluding those om outlying districts in the branch, ere VK2ANF, 2VW, 2YC, 2OA, 2AOA, JZ, 2MQ, 2HO, 2ABB, 2QZ, 2EO, 2YR, IE, 2HL, Cec Cronin.

A wide range of UHF equipment was on splay ranging from beam antennas to mplete stations. The demonstration eated so much interest and enthusiasm at members were still admiring the eces after midnight.

Members of the section who lectured to e branch on UHF subjects were Berry eresford, VK2ABB, who covered the HF fields generally, UHF president John iller, VK2ANF, who lectured on Cascode nverters, and secretary Harry Solomons, K2AJZ, on the subject of flat strip for near lines.

THER NEWS

Besides the normal local working, main tivity in NSW has been on extended ound wave work on 50 and 144 Mc, al-ough the former band did open to ew Zealand on one occasion late in ebruary.

Arch Cox, VK2GU, and Ron May, K2PM, of Canberra, and Hugo Stitt, K2WH, of Forbes, are still supplying ost of the interest for Sydneysiders.

Peter Adams, VK2JX, of Wentworth alls, 3000ft up west of Sydney, has been ntacting VK2GU and VK2WH on 6 etres over distances of 130 and 140 miles spectively. Both bands were open to e north from Sydney but no signals peared; perhaps the visit of the UHF oup to the coalfields will have the de-red effect of promoting greater activity.

One of the strongest DX signals heard r a long time came from KG6ADX. opagation conditions were perhaps just ght but stacked 8JKs at 45 and 66ft vels might have helped. He was on 14 c and the array has been arranged to ver 21 and 28 Mc also.

NOTHER EMERGENCY

Late in February amateurs on the rth coast of NSW were alerted when eavy rain caused river levels to rise. Portable gear was tested and batteries arged in readiness. Some transmitters ere tested on the police frequencies of 52 and 6915 Kc. Fortunately the flood vels did not affect normal communica-on circuit.

DX on 3.5 Mc during the evenings to merica in February was perhaps the est yet experienced. Signals from right cross North America were very good different times.

Up to a dozen stations were contacted some amateurs—static permitting, the metre band providing some good tele-hony signals. W stations running the ll kw were perfectly readable often to RST 579.

Some European DX has been audible round sunrise on the band and worked Jack de Cure, VK5KO, who still seems to be able to contact stations not heard in the eastern States.

The QSL business is still in a decline and seems to be running out of fashion. The number of cards being handled by bureau is only about 50 pc of that in peak years. Cards handled in 1952 were 25,000 compared with 45,000 normally in the W7 bureau.

The Victorian division of the WIA ran during the year a series of accurate frequency transmissions. The next transmission will take place on the 3.5 Mc band on May 21. The initial announcement will be made at 1950 hours, EAST, on 3573 Kc and then at 2000 hours the first frequency check transmission will be made on 3500 Kc. The next frequency will be 3515 Kc, then 3545 Kc, and in 30 Kc steps. A band edge marker transmission will also be given on 3800 Kc.

YOUR OPPORTUNITY

join the world-wide ranks of amateur ansmitters! The Wireless Institute of ustralia holds regular classes in Sydney assist Sydney and suburban enthusiasts obtain their Amateur Operators Certi-cates of Proficiency.

rite for particulars to the Class Man-ger, W.I.A., Box 1734, G.P.O., Sydney.

For Gliding and Soaring News

"AUSTRALIAN GLIDING"

Journal of the Gliding Federation of Australia.

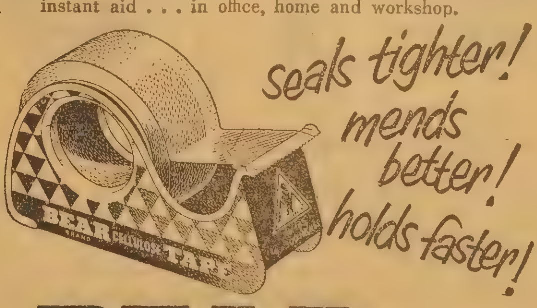
Published Monthly, 12/- per year.

3, Bodwen Street, North Parramatta, N.S.W.

When you have an awkward parcel

a little
BEAR
will fix it!

A little "Bear Tape" will do hundreds of every-day jobs more quickly and easily. It seals at the pressure of a finger and hugs like a bear. *It's better! It's the only tape specially made to suit the Australian climate!* You can count on "Bear Tape" for easy, economical, instant aid . . . in office, home and workshop.


seals tighter!
mends better!
holds faster!
BEAR BRAND CELLULOSE TAPE

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B R A N D
TAPE

Made in Australia by
BEHR-MANNING
(AUST.) PTY. LTD.
Manufacturers of
Surface Coated Abrasives, Pressure Sensitive Tapes, Adhesives and Coatings

When visiting Sydney for . . . . .

Easter

You are cordially invited to call on us and discuss your Radio problems

FULL STOCKS OF ALL THE BEST RADIO COMPONENTS ARE AVAILABLE INCLUDING, GRAMO MOTORS, PICKUPS AND TEST EQUIPMENT.

COMPLETE KITS FOR ALL RADIO & HOBBIES RECEIVERS AND AMPLIFIERS

SPECIAL EASTER RELEASE
OF
Disposals Units and Components

PRICE'S RADIO

5-6 Angel Place, SYDNEY

First atomic shell

THE United States Army will so
fire the world's first atomic she
The army's new 280 millimet
atomic artillery cannon will fire t
shell.

The test will be part of the spri
series of nuclear experiments at t
Nevada proving grounds.

The Defence Department and th
Atomic Energy Commission an
nounced jointly that an army un
would fire the new atomic gun, "usin
a projectile armed with an atomi
warhead."

A Defence Department spokesma
said troops would participate in th
test firing as part of a "combat exercise to simulate actual combat con
ditions."

He refused to say whether th
gun would be actually manned, o
fired by remote control.

He said it was "conceivable" another of the huge cannon would fir
a conventional shell to obtain comparative data.

The cannon, which weighs 85 ton
and has a range of 20 miles, wa
first unveiled to reporters at th
Aberdeen proving grounds, Maryland, last October.

Present plans call for 10 atomi
bursts at the proving grounds between March 17 and the end of May

The other nine bursts, under present plans, will include seven from high towers and two dropped from bombers.

WATCH for fraying condition of a
soldering-iron power cord. It
is best to be wise before an event.

AUSTRALIAN MANUFACTURERS MEET THE DEMAND—ANNOUNCING THE NEW ZEPHYR "MODEL IXA" CRYSTAL INSERT

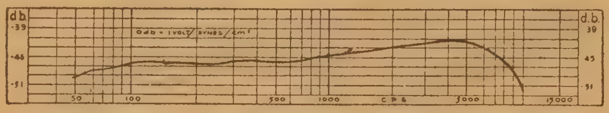
ZEPHYR

1 13-16in dia.

⅜in

1½in dia. (Rear)

AVAILABLE FROM ALL RADIO STORES



APPROXIMATE FREQUENCY RESPONSE CURVE

- **Australian made throughout**
- **Patented crystal unit guarantees outstanding efficiency and performance.**
- **Protected against ingress of moisture with approved moisture sealed crystal element.**
- **Small — compact — lightweight — durable.**
- **Will not blast from close speaking.**
- **Precision engineering ensures realistic reproduction and high output with long life and dependable operation.**
- **Good high frequency response ensures excellent speech reproduction.**
- **Aluminium diaphragm mechanically protected and frequency controlled by "Zephyrfil" filter.**

If unable to obtain from your Dealer write direct to:—

ZEPHYR PRODUCTS PTY. LTD.
118 WATTLETREE RD., ARMADALE, SE3. VIC.

PRICE
57/6
RETAIL

IMMEDIATE DELIVERY

TRADE INQUIRIES INVITED FROM MANUFACTURERS & WHOLESALERS

TUNING IN" TO BRAIN WAVES

(Continued from Page 13)

:ach fibre has its own character-
c speed of transmission. One can
nulate a nerve with the strongest
ctric shock, but it will still only
nsmit the impulse at its own
iracteristic speed. The nerve seems
be tuned as it were to that speed
ich as the string of a piano or
lin is tuned to a note.

Verves also have what scientists
l a "Threshold Value." This means
it a stimulus must be of a certain
ength for the nerve to set up an
pulse. A weak electric shock may
ve no effect. A strong shock may
o be ineffective. If a weak shock
first applied and gradually raised
intensity, a point will be reached
iich is just sufficient to set up an
pulse in the nerve. No more and
less.

REQUENCY EFFECTS

Frequency has a lot to do with our
ility to discern between hot and
ld, loud and soft, a dim and bright
ht, faint and strong odors, degrees
pain, &c.

It is not stronger impulses set up
the nerve that enable us to differ-
tiate between these things. It is
e frequency with which the im-
lses are transmitted along a nerve
re.

As mentioned above, each nerve
ll transmit only impulses of a cer-
in size. It is impossible for a nerve
transmit any but its own size of
pulse.

Let us assume that, say, a cold
nsation will transmit 50 impulses
second along a nerve fibre at its
aracteristic speed. A hot sensation
ay transmit up to 100 or more im-
lses a second, but at the same
eed. Thus, a nerve fibre can only
ter the message it is transmitting
modifying the rate of impulses.

How the brain translates these
pulses into measures of degrees of
nsation has not been elucidated.

Sometimes a message is short-
cuited from one nerve fibre. This is very useful to the doctor in diagnosing certain diseases. For instance, in certain heart conditions, such as angina pectoris, pain is felt in the left arm. By some means the nerve impulse has short-circuited and gone over into a nerve which transmits pain impulses from the arm. There are several of such conditions and the surface of the human body has been mapped out, as it were, into areas where pain has been found to be connected with a disease of some internal organ. This is a great aid to diagnosis.

The action of the nervous system is, no doubt, bound up closely by electrochemical action. The evidence is irrefutable. Aside from the function of sodium and potassium as outlined, a nerve uses oxygen and discharges carbon dioxide. It breathes, and this breathing is a chemical process.

An active nerve fibre conducting an impulse becomes slightly warmer even if measurements have shown that the rise in temperature is only 1-10-millionth of a degree centigrade. Thus, when the nerve works, it uses up oxygen, exchanges sodium and potassium and in doing so becomes warmer, thus showing that energy is released. This energy is partly heat energy and partly electrical energy.

The peculiar similarity of the nervous system and an electrical system would take up many more pages. Sufficient has been said, however, to show that man is inexorably bound up with chemicals and electricity.

These discoveries hold out great promise in the field of medicine and psychiatry.

Diagnosis of disease is becoming more and more a matter of analysing the brain waves and nervous impulses of the patient. Equipped with the necessary instruments, a practitioner of the near future will be much more sure of his ground than he is today.

EARTH'S CORE STILL A MYSTERY

(Continued from Page 9)

equency of ten an hour, a wave-
igth of 1000 miles and travelled
er the surface of the earth with
velocity of 2.5 miles a second (9000
les an hour).

So responsive was the new seis-
ograph that it was able to record
ese waves making eight complete
rcuits of the earth, a travel dis-
nce of 182,000 miles. The chief
terest of Professors Ewing and
ess was in the internal waves,
iich were similarly recorded, giv-
g a record that was very com-
ex and required a long time for
alysis.

In the case of the Kamchatka
rthquake, a straight line through
e earth connecting it with the
amont Laboratory would reach a
pth of 1000 miles, or about 500
800 miles from the core. The
cords showed that the very long
aves travelling this straight-line
ute failed to exhibit the increase
wave length with increase in depth
at is found in shorter waves. The
pposedly dead, inert core was ap-
parently reaching out to produce an effect some hundreds of miles beyond its supposed boundaries.

"We interpret this failure of the longest waves to increase in velocity to mean that they are 'feeling' the liquid core of the earth," said Professor Ewing. "If the centre of the earth were solid, we would expect a continued increase in velocity with wave lengths as the transmitting medium became more dense."

Waves from an earthquake in Japan would pass much closer to the core. There was a great earthquake in India in 1950. A straight line from that site to New York would pass through the northern cap of the core.

The South Pacific area is a prolific producer of strong earthquakes. A straight line in this case would pass close to the centre of the core. Earthquakes in any of these areas would provide core-testing experiments.

A FREQUENCY METER FOR UHF

(Continued from Page 73)

around the inner ring after splitting. The dimensions of this ring, after shaping for better tuning characteristics, are given in Fig. 5.

The dielectric tube which spaces the two split cylinders is fabricated by winding two layers of thin wax-paper around the handle tube, extending from the edge of the retaining collar to the end of the split cylinder. This tube is cemented at the seams with *Duco* cement so that it will turn smoothly on the brass tube.

A layer of white bond paper is then cemented over the wax-paper and the outside tuning ring is fastened to the tube thus formed so that its position coincides with the inner ring when the edge of the dielectric tube is held against the retaining collar. A piece of graph paper is cemented to the dielectric tube up to the retaining collar to provide a calibration scale.

The frequency meter can be used in this form to determine the frequency of circuits which have metered plate or grid circuits, or ones where a meter can be conveniently inserted.

INDICATING METER

For non-metered circuits, however, the frequency meter can be made self-indicating with little additional effort by mounting a coupling loop and crystal detector circuit within the handle so that it samples the magnetic field within the resonator.

The rectified current, which increases abruptly when the frequency meter is tuned to resonance, is indicated by a meter connected to leads brought out through the handle. The circuit of this indicator, as well as a sketch of the physical arrangement, is shown in Fig. 6. Any meter with a fullscale reading of one milliampere or less will be suitable.

If a microammeter is used, less coupling is required between the frequency meter and the circuit being measured, resulting in better accuracy.

The absorption meter must be calibrated against a standard such as a calibrated UHF signal generator or a variable-frequency UHF oscillator in turn calibrated by means of an accurate Lecher wire system. Enough points should be taken to allow marking a frequency scale on the graph paper attached to the paper tube.

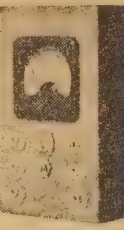
After the scale is calibrated, the exposed portion of the paper tube is covered by a smooth layer of transparent cellulose tape to protect it and prevent moisture absorption.

References

(1) E. Karplus, Wide Range Tuned Circuits and Oscillators for High Frequencies. Proc. I.R.E., July, 1945.

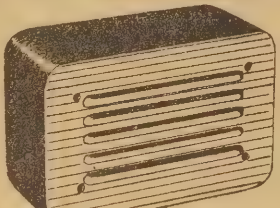
USE care in the insertion or removal of valves from their sockets. Rough handling in this respect can lead to a broken spigot in the case of octal-based valves and bent pins or a cracked envelope in the case of the miniature types.

CHIEFTAN MULTIMETER



For the Radio Repair Man, Amateur Experimenter, Motor Mechanic and 'Electrician. This pocket size multimeter is ideal. D.C. Voltage. Readings:— 0-15, 0-150, 0-300, 0-600 OHMS scale: — 0-10,000 OHMS. The dial is exceptionally easy to read and the meter will stand up to any amount of hard work.

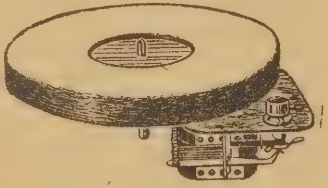
Price £3/19/6
Weight 1lb.



METAL SPEAKER BOXES

(As illustrated.) Finished in Grey or Cream Wrinkle finish, very attractive. Size is ten inches long seven inches high, four inches deep. Specially designed for 6 x 9 Oval Speaker. Worth 30/- each. Our price 10/6 ea.

Can be supplied with Speaker fitted for 55/- ea.
Weight 2lb 2oz., with speaker 4½lb.



3-SPEED GRAMOPHONE MOTORS

Well-known English make with heavy turntable, adjusting knob changes motor speed to 33, 35 or 78 R.P.M. ideal for new Microgroove Records. Normal price £8/10/-.

Our Price £5/10/-
Weight 7lb.

Turnover Head Type Crystal Pickups to suit 3 Speed Motors **(Above) £5/5/-**

NOTICE

All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.

SPECIALS! SPECIALS!

FOR APRIL

1. FD 32 Dials 15/-.
2. Philips' Log Dials, ideal for instruments and short wave radios, etc., 15/-.
3. B & E Straight line Dials 10/-.
4. Condenser Banks 4 x 500 mfd 12PV Electrolytic Condensers mounted on one metal plate. Worth 17/6. Our price 4/-.
5. Block Condensers ex. British Navy .1-4000 Volt Wkg only 4/6.
6. Oak type Wafer Switches with 1 pole 3 position and 1-2 way switch on same wafer, long shaft. Only 2/6.
7. Audio Driver Transformers 1½ to 1 only 5/-.
8. Magneto Coils, only a few left, 4/- each.
9. 200 yd coils Aerial Wire, 7 strands steel and 1 copper insulated and waterproof. Ideal for telephone lines, radio aerials, etc. Worth 30/- Our price 15/-.
10. 1 mf 1500 Volt Wkg Block Condensers 5/9.
11. .5 mfd 8000 Volt Test Condensers 4/6.
12. Vertical type Car Radio Dials as used in Late model Dodge, etc. Worth £4/10/- each. Our price 25/-. Remote cables extra.
13. 100ft lengths steel insulated Aerial Wire 1/6 ea.
14. Dynamic Microphones suitable for home broadcasting, experimental work, etc., in bakelite housing. 7/6. Dynamic Microphone Inserts 5/-. Bakelite Case for same 2/6. Matching Transformers for Dynamic microphones 4/6.
15. Carbon Pots miniature size suitable for portables, etc., 30T ohms 1/3.
16. Metal spacers ¾ inches long for 1/8 or 5-32in Screws 1/- doz.
17. Phone and Microphone Cords, length approx. 7ft, rubber covered, 1/6 ea.
18. Headphone Cords, cotton covered, with phone plug attached, 3/9 ea.
19. 40 ma Power Transformers 240 volt input, 5 and 6 volt Filaments 240 aside output. Should be 39/6. Our price 25/- each.
20. 40 ma Power Transformers 240 volt input, 5 and 6 volt Filaments 385 aside. Should be 47/6. Our price 30/-.
21. Car Radio Vibrator Transformers 6 volt to 250 volt. Should be 39/6. Our price 17/6.
    12 volt to 250 volt. Our price 17/6.
22. 9000 ohm CT to line 250 ohm Transformers 10 watt 12/6.
23. 80 ma Pwr Transformer 240 primary. 2-6.3, 1-5 volt, 385 aside secondary. Worth 95/-. Our price 50/-.

FOR APRIL

24. 6 volt input to 90 volt output Vibrator Transformer. Worth 35/-. Our price 22/6.
25. 100 ma Power Transformers. 230 volts input, 2-6.3 at 3 amp and 1-5 filaments, 385 aside. Worth £5/10/-. Our price £3/10/-.
26. Similar to 100 ma Transformer above but with 325 aside secondary £3/10/-.
27. 6 volt input to 135 volt output Vibrator Transformers. Worth 35/-. Our price 22/6.
28. Class B. Audio Transformers. Usual price 22/6. Our price 12/6.
29. 250 ma 10 henry Chokes. Excellent for heavy amplifier work. Usual price 72/-. Our price 43/6.
30. 14 henry 60 ma Chokes. Worth 13/9. Our price 9/-.
31. 20 henry 80 ma Chokes. Worth 35/-. Our price 21/9.
32. Aluminium Chassis, drilled size 16 x 9½ x 2¼ 2/- ea.
33. Vernier Drives suitable for instruments, small portables, car radios, etc., each control fitted with indicating pointer to suit ¼in shafts. Worth 12/6. Our price 7/6.
34. Well-known Tru-trak Magnetic Pickups. Worth 57/6. Our price 10/9.
35. Indicator Lamps made of black bakelite with red or clear glass, these are ideal for instrument panels, tail lights on trailers, etc. Screw in torch globes fit into these lamps. Worth 5/6. Our price 1/9.
36. Carbon Pots. Most of these are ex. British Navy and are 1st-class and unused. Available in following sizes.
    5,000 ohm 2/6.
    10,000 ohm 2/6.
    250,000 ohm 1/9.
    500,000 ohm 2/9.
    1 meg ohm 2/9.
    2 meg ohm 3/9.
    Also available in Wire Wound type.
    50 ohm 5/-.
    2,000 ohm 3/9.
    10,000 ohm 3/9.
37. Brand new Speaker Transformers. A type is available to fit any normal speaker. Let us know your output valve and speaker types and we will supply a suitable transformer. Single end and push pull types available. All sizes suitable for up to 10 watts power. Normal price 16/6. Our price 9/6. Prices for larger transformers on request.

MOTOR SPARES LTD.

547 ELIZABETH ST.
Melbourne

BRANCHES THROUGHOUT VICTORIA AND RIVERINA

Here's your answer, Tom

Continued from page 35

ly to be adversely affected by and humidity.

he contacts must also open and e rapidly to prevent arcing in presence of the higher voltage.

ast comes a question in which authorities are very interest- How effective is the insulation ween the electrical circuits and possible operator of the switch?

lany little switches for torches, lamps and so on have a metal er or a metal toggle arm or h. Some have no insulation at between the metal toggle and circuit; in others it might be very dubious nature. A bit too ich humidity or a mechanical lure in the mechanism might sily allow the full circuit voltage reach the fingers of the opera-.

With just a few volts present, this of no consequence, but, with the ains voltage involved, it would be other matter.

So, Tom, we guess that the switches u saw advertised "for battery sets ly" had only a limited amount of sulation between the two circuits d likewise little or none between e circuits and the external metal ver or toggle.

We'd say that the retailer was an nest person—and very wise!

OLUME CONTROL

How does a volume control on a ireless set work, and why do you ave to have one, anyway?

The last part of your question uggests that you are about ready o have a stand-up fight with the ext radio designer you meet. There re plenty of obvious reasons for a olume control on a radio, Tom.

For example, the level of sound hat would help to make a romantic etting on a moonlit night would ertainly not do full justice to Johnny Ray. (Some will agree that that night be a good thing.)

Also the signal received from the radio station will not always be of the same strength. Factors such as the power of the station, its distance from your location and also the efficiency of your aerial, will all influence the strength of the signal you receive.

Having, we hope, convinced you of the need for a volume control, a few words about volume controls used in different types of sets will answer the other part of your question.

Volume control was no problem in the days of crystal sets. Signals were rarely as loud as could be desired and everything was aimed at making them as loud as possible. Different crystals were tried, better coils were designed and manufacturers vied with one another to turn out the most sensitive pair of headphones.

In the rare event of the signals being too loud for comfort the listener could simply not clamp the phones tightly to his head or alternatively, a comfortable volume could be achieved by detuning the receiver slightly.

Then came receivers equipped with amplifying valves. As the number of stations operating became greater it was not always satisfactory to simply detune the receiver because of the possibility of receiving interference from stations operating on nearby frequencies.

A rough and ready means of controlling the volume was frequently used. A rheostat was placed in the filament circuit so that the voltage applied to the valves could be varied. This, in turn, varied the efficiency of the valves as amplifiers.

It was a ready means because low resistance rheostats were easy to make, cheap and reliable. It was at the same time extremely rough because the valve operated with the low filament voltage introduced a large amount of distortion. At the time, distortion introduced by other parts of the system was so great that a bit extra generated in the receiver didn't matter so very much.

Regeneration was an important step in the development of receivers. By taking a small amount of energy from the output circuit of an amplifier and feeding it back to the input circuit in a controlled manner the gain and selectivity of the amplifier could be enormously improved.

The regeneration control, therefore, could be made to double as a volume control with the disadvantage that the volume and selectivity were interdependent, the control was, in most cases, somewhat critical to adjust and the range of control was limited.

These methods were simply incidental in the development of receivers. Eventually it was possible to produce a receiver with a reserve of amplification for most situations and a more satisfactory method of control had to be found. Many modern receivers are capable of amplifying extremely weak signals to loudspeaker level and their full capabilities in this respect are seldom required. However, the full amplification must be easily available for when it is needed.

There are many occasions when the receiver will be tuned to strong local signals when a large amount of energy will be applied to the grid of the first valve. If this signal were amplified to the same extent as the weak signal an enormous signal would appear in the output.

VALVES OVERLOAD

In practice, the first valve amplifies the signal and passes a stronger signal on to the second valve. With a very strong signal to start with it may be that the signal applied to the second valve is so great that it is incapable of dealing with it. Being a willing worker, the valve passes on as strong a signal as it is able.

The same thing happens with every subsequent valve along the line until finally a horrible, distorted sound is produced by the speaker. Thus, it is very important to see that in no case is the signal applied to a valve of greater strength than it can handle.

One way of varying the amplification is to have a resistor (in modern receivers it is usually between .25 and 1.0 meg) with a variable tap. The device is so arranged mechanically that the position of the tap can be varied by means of a knob on the front of the set.

The signal from the earlier stages of the receiver is applied so that it appears across the whole of the resistor. The input terminals of the following amplifier are connected one to one end of the resistor and the other to the variable tap. By varying the position of the tap, you can supply the amplifier with anything from the full output of the earlier stage to only a small part of it.

Modern receivers mostly use this type of control and the most convenient place for it is straight after the detector stage, immediately before the audio amplifier. Frequently the resistance element is given a special taper to make the control work smoothly right from full volume to low volume.

Unfortunately, this isn't the full story. Modern receivers often have several amplifying stages before the detector. Not only do they increase the gain but the additional tuned circuits improve the selectivity.

AUTOMATIC CONTROL

This high gain before the detector is all very well for weak stations but local stations are likely to overload the amplifying stages even before the detector. The variable resistance type of volume control just mentioned isn't very suitable for controlling radio frequency amplifiers and in practice quite a different system is used. It has the advantage of working automatically and makes the receiver very much smoother to operate than it would be otherwise. Practically all modern receivers are equipped with automatic volume control.

Before it will work, it is necessary to have a special type of valve which has what is known technically as variable mu characteristics. With this valve, full amplification is given when the bias is, say, zero or minus 3 volts, depending on the particular valve. However, when the negative bias is increased the amplification factor of the valve decreases. With minus 20 volts applied to the grid, the amplification of the valve may be very small.

You will be on the point of asking where the negative bias comes from. Well, Tom, when the detector deals with the signal it provides not only the audio to be passed on to the audio amplifier but also a steady negative voltage.

The magnitude of this steady negative voltage depends on the strength of the signal received at the detector. A strong signal will cause a large negative bias to be developed and when this is applied to the grids of the variable mu valves their gain is reduced. This, of course, decreases the signal applied to the detector and hence the negative bias. However, a special time constant circuit is introduced and the system adjusts itself to a steady state.

In effect, the amplication of the receiver automatically adjusts itself to suit the strength of the incoming signal. Of course, when the signal from a distance fades with changing ionospheric conditions the AVC tries to take care of this, too. Provided the fading isn't too great you wouldn't even notice.

AVC systems can become quite complicated if it is desired to make them very comprehensive but that also is a story we will leave until another time.

HOW TO BUILD A GARDEN POOL

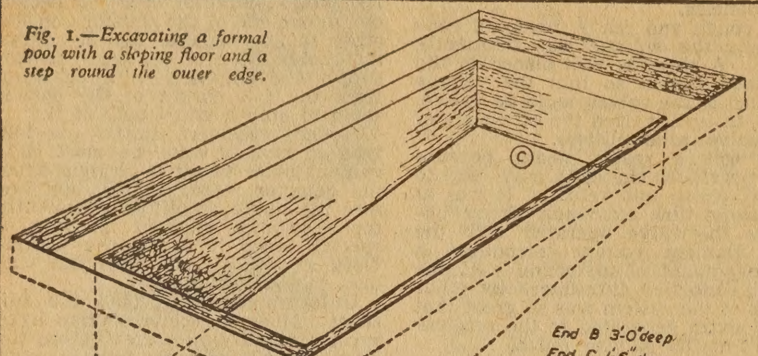


Fig. 1.—Excavating a formal pool with a sloping floor and a step round the outer edge.

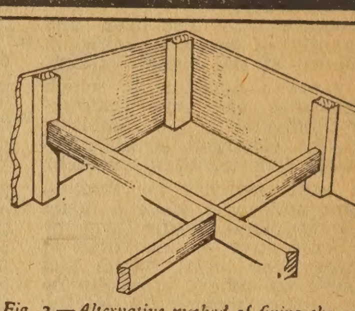


Fig. 3.—Alternative method of fixing the cross struts.

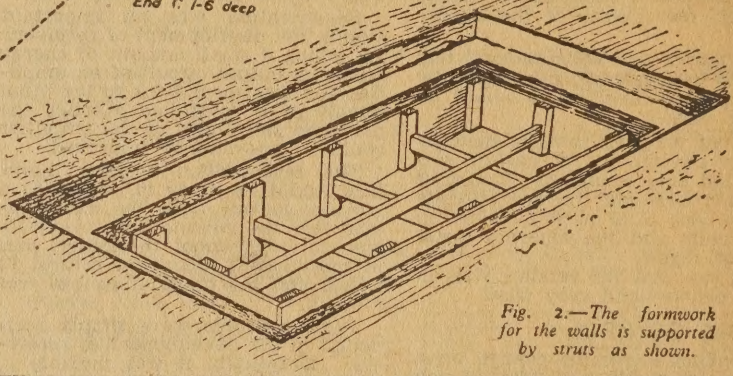


Fig. 2.—The formwork for the walls is supported by struts as shown.

Preparations for a formal pool involve excavating the site to the appropriate dimensions, then the construction of a timber framework to support the walls until set.

Few things will add as much charm to a garden than a well-placed pool. If large enough, it can be used as a play-pond by kiddies, or, alternatively, be decorated with small fish and ornamental moisture-loving plants.

THE construction of a garden pool is one of the most satisfying of the major jobs to be undertaken in a garden, and it is a comparatively simple one, too. It does, however, call for a little planning before work is commenced.

To begin with, is the pool to be a formal one of regular shape, or an informal one which simulates as far as possible a miniature natural pond?

The answer is that it must agree in character with the nature and planning of the garden, or that part of the garden of which it is to form a feature.

A garden of a regular outline defined by walls or trimly-clipped hedges needs a formal pool; one in which there are a number of trees and in which large areas are left under rough grass would make a framework for an informal pool.

Generally speaking, the smaller the garden the more suitable is the formal pool. Only the garden owner will be able to assess the suitability of either type.

The site having been chosen, the ground is excavated to a depth and width that will allow for a wall and floor thickness of six inches. Therefore the excavation will be 6in deeper and 1ft wider than the internal dimensions of the finished pool.

It is best, especially if fish are to be kept, to make provision for varying depths of water. In the breeding season the fry will thrive in water of a depth of 4in to 6in. In the hot summer days the fish will seek the deeper parts of the pool.

The shallowest levels are best arranged by providing a sort of step around the outer edge of the pool, as is seen in Fig. 1, and the floor of the pool may slope from a depth of 1ft 6in to a depth of 3ft.

The floor is formed first, pegs being driven into the ground at suitable intervals to indicate the finished level of the floor. These pegs are removed as the concreting proceeds.

The concrete mix for this kind of work is the "One-two-three mix," which consists of one part cement, two parts sand and three parts shingle; or, alternatively, if you have difficulty in obtaining shingle, one part cement to four parts mixed ballast.

Remove from the ballast the few stones there may be which are more than 2in in diameter.

Mix the concrete on clean boards or a swept, paved area, laying out the shingle and sand or the ballast in a flat heap and then spreading the cement evenly over it. The whole heap is then turned over with a shovel until it is thoroughly mixed.

Water is added from a watering can with a rose nozzle, stopping frequently to turn over the mix. This continues until all the materials are thoroughly incorporated.

The concrete should be of a consistency which will hold its shape when squeezed in the hand and will become damp on the surface without actually dripping.

It must be placed within half an hour of being mixed and roughly levelled with the flat of the shovel. The outer 6in at the edge of the floor concrete should be left rough, indeed; if necessary, roughened so that the wall concrete will form a good bond.

In three or four days the floor will be sufficiently hard to walk on and the framework for the walls may be erected. This is made out of 1in thick boards, strongly nailed to braces of 2in x 3in timber at intervals of about 2ft.

It is set up 6in from the sides of the excavation and firmly strutted in place. Lengths of old quartering bought at the local secondhand yard do very well for the strutting, and usually 4in x 2in wood is stout enough for the purpose, although it must be remembered when fixing the struts that they will have to resist a considerable pressure.

CROSS STRUTS

If the pool is not a large one, the struts may be arranged to cross the width and length and be secured to the 3in x 2in braces of the framework, as shown in Fig. 2. Where the pool is too long for this the lengthwise struts may be cut in their length and fitted tightly between the cross struts, as shown in Fig. 3.

Before final placing, the inside of the formwork should be coated with either oil or whitewash to prevent the concrete from adhering to it.

Just before filling in the walls, the bottom of the space between the forms should be coated with grout. This is a mixture of equal parts of cement and sand mixed with water to a thick cream, and it ensures perfect adhesion and a complete bond between the wall and floor concrete.

These precautions are necessary to prevent leakages at this point.

The wall concrete is placed in

's, working all around the form- :. It will be found convenient to it from a bucket, working along side and end. After completing circuit of the pool take a length mber and consolidate the con- by vigorous poking up and n.

e formwork should be carefully oved after four or five days and pool half-filled with water. This prevent the concrete from drying too rapidly.

ere may be a considerable drop he water level at this stage, be- e a fair amount of water will be rbed by the concrete, and also es by evaporation must be taken account if the weather is hot.

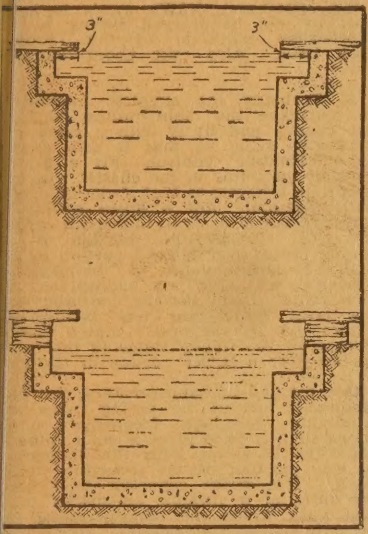


Figure 4 (top): Using concrete slabs to cover the edges of the pool walls. An alternative method, involving the construction of dwarf walls is shown in figure 5 (bottom).

he edges of the pool are best laid precast concrete slabs and it is best allow the slabs to project over the de of the pool to hide any irregu- rities in the walls (Fig. 4). Alter- tively the walls may be built up r a few inches with thin slabs and e whole surmounted by a coping, shown in Fig. 5.

Before plants are introduced into e pool it should be treated in the llowing manner. Fill it and then d potassium permanganate crystals til the water is a deep pink, and en leave it for ten days.

It is then emptied and the process peated.

At the end of the second ten days is emptied and then finally filled. btain reliable advice before plant- g with aquatic plants and stocking ith fish, to avoid losses and disap- intment.

The informal pool is made regular both in plan and depth. In ction the hole should be saucer aped, with the same flat sloping des as has a saucer.

The bottom is left irregular — in ct fish will appreciate one or two ite deep holes. These, too, will ake convenient planting places for ants such as water lilies.

No formwork is required for the formal pool and the concrete is ixed in the proportion of one part ment to three parts sand. This is erely spread over the excavation th a trowel to a depth of about 3in. is kept from drying out too quickly by frequent sprinkling with water, or by covering with wet sacks.

After two or three days it may be filled with water. It will, of course, need the same treatment as the formal pool before planting and stocking.

The edges of the informal pool may be defined by rocks and boulders between which may be set moisture-loving plants.

These rocks are easily made out of concrete. An irregular hole is dug in firm soil, in size and shape equal to those of the rock required. The bottom and sides of the hole are then thickly sprinkled with sand, brick dust or similar material to give the surface of the rock color and texture.

Concrete is then mixed in the proportion of one part cement to four parts sand, mixed with water to a stiff consistency, and placed in the hole. Take a number of old tins, jam jars, &c., and thrust them into the centre of the concrete. This gives both lightness and economy of concrete. Place more concrete on top and sprinkle with sand. Leave the rock to harden for four or five days according to the weather and then remove the soil around it and lift it out.

Rocks and boulders made in this way may also be made of colored concrete and used to form rockeries or to support shelving banks in the garden.

FAILURES IN RADIO EQUIPMENT

(Continued from Page 17)

during the 1000-hour test period. Sixty-five of these failures, or about 80 pc, were of a gradual and predictable nature—either low transconductance or gassiness—while the other 14 were caused by unpredictable open heaters (seven) or shorts (seven).

Fifty-eight of the 65 predictable tube failures were accurately predicted many hours before the receiver failed. Of the seven predictable failures not successfully predicted, two were in stages not being checked, four were in a single stage where parasitic oscillations interfered with measurements, and one was masked by the change in value of an overloaded resistor. Failures of components other than tubes were negligible and do not warrant any conclusions as to predictability.

The success of the experimental work at NBS suggests that provision for simple failure-prediction routines for the maintenance of important electronic equipment deserves the serious attention of design engineers.

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ANSWERS TO CORRESPONDENTS

J.F.M (Camberwell, Vic.) is interested in noise limiters for radio receivers.

A. Articles making mention of noise limiter circuits have appeared in Radio and Hobbies at various times. The limiter included in the "Outboard IF Channel" which was described in the May, 1950, issue included a limiter which we found to be particularly effective. It appears to be fairly similar to the one you have in mind. If you require something more elaborate, the best we can do is refer you to the ARRL handbook which includes what is known as the Lamb noise silencer. Other information on noise limiters will be found in the same book.

R.H. (Newcastle, NSW) wants to know where he can get information about tape and disc recorders.

A. We have no publications to offer from this office on the subject, the only reference being to articles which have appeared from time to time in Radio and Hobbies. If you can dig out back numbers for the past 12 or 18 months you should find a good deal of information of the type you require. Other than that, we can only suggest that you get in touch with a technical bookseller and ask for titles and prices of books dealing with the particular subject. By way of example, you could write to Messrs. Angus and Robertson, 89 Castlereagh St., Sydney.

A.R. (Yarraville, Vic.) writes to suggest printing a number of small items which might be of use to readers.

A. Thanks for the suggestions, A.R. They are practical but would only aggravate the present task of keeping up with the work in hand. At present both the editorial and mechanical staffs are working to capacity. In any case, things like color codes are often printed by component manufacturers as a sales aid and are also available from text books. Your listening set up appears to be growing to quite impressive proportions. Best of luck with your projects. We have set aside your remaining question for treatment in the Answer Tom page.

G.L.S. (Brisbane, Qld.) says he has built up a set which is essentially a Little General with an R.F stage added. He has included a dual-wave coil unit and reports that results are very good on both bands.

A. Your circuit appears to be quite in order and we can see no reason to make any changes. The only obvious comment is that most sets of this size nowadays have provision for AVC in order to minimise fading on distant signals. However, it will not in any way improve the set's ability to receive weak stations. We are hanging on to a couple of 5BP1 tubes for possible use in a small television set, even though their screen characteristics are not ideal. However, we can't offer any circuits yet.

J.D. (Temora, NSW) says he has all the necessary parts for a crystal set and wants to know whether there would be any chance of receiving signals, the nearest station being 50 miles away.

A. It would be a gamble J.D. but possibly worth a trial since you have all the necessary parts. The most important thing would be to erect a very efficient aerial, say up to 100 feet long and as high as you can get it. The circuit could be straightforward except that the aerial would need to be tapped further up the coil from the earthed end than would be done if the stations were closer.

C.H. (North Cottesloe, WA) has built up one of our amplifiers which works excellently. However, on rechecking the wiring he finds that he has omitted the grid stopper resistors from the output valves. As it is a difficult job to include them in his present layout he wonders if this is important.

A. If you are sure that the amplifier is not oscillating or showing signs of instability on peaks we suggest you leave the matter as it is.

A.V. (Blair Athol, SA) sends in some comments on reaction control circuits.

A. Many thanks for your letter, A.V., and it is interesting to note your impressions. We found that with battery valves screen control of regeneration wa not always satisfactory because it wa not possible to arrange for the detecto to oscillate always with the optimu screen voltage applied. The screen vol age has a marked effect on the perform ance of the valve as an audio amplifie Care has to be taken with very large re action windings to make sure that the do not take over control of the tunin of the set.

R.A. (Bathurst, NSW) wants to kno how to add bandspread tuning to th short-wave converter of the Januar 1948, issue. Also asks about the 2A valve.

A. Probably the simplest method i to rearrange the main tuning gang o the chassis and fit it with a knob an graduated scale so that it acts merel as a "bandset" control. Fit a 3-plat variable capacitor to the chassis with ap propriate brackets so that it can be drive with the dial. For a given setting o the bandspread control, this small capaci tor will "spread" that portion of th tuning range over a good portion of th dial. A larger value of "bandspread capacitor will give less bandspread an vice versa. Don't become confused wit the terms "more" and "less" bandsprea "More" bandspread means that a smalle portion of the tuning range of the set i spread over a larger portion of the dial

One method of bandspreading the hig frequency end of the tuning range an extending the high frequency tunin range slightly is to place a small value o capacitor in series with the connectio to each section of the 2-section tunin gang. The series capacitor best take the form of a variable air-spaced trim mer with which the bandspreading ca be adjusted to suit oneself. Remember however, that this will completely alte and considerably reduce the existin tuning range of the set. We have n immediate plans for the description o a new double-conversion short-wav superhet. The 2A3 valve has retained th same characteristics over the year otherwise the type number would no apply. It is true that it is still in fairl wide use in certain equipments wher conservation of space is not importan This does not necessarily infer that i cannot be improved upon and, in poin of fact, there are one or two types avail able overseas which are even bette triodes than the "old faithful" 2A3.

G.J.W. (Port Macquarie, NSW) ask for information on elimination of inter ference caused by fluorescent lighting.

A. By and large, fluorescent lights d not cause interference with normal radi reception. In the case of "DX" listenin where the last vestige of such inter ference, if any, has to be cleaned up, i is a good plan to seek the advice of th manufacturer's expert on the matter. I such cases, a lot might depend on whethe the light is wired to the mains in ope wiring or in wiring enclosed in condui in good condition and also whether th remainder of the wiring in the buildin is in good condition. There are occa sions, of course, where a particular tube faulty tube sockets, starters or other ba fittings do give rise to interference. I this case, the remedy is obvious. Some times, an allegedly faulty tube can b traced back to a faulty ballast. Th power factor capacitor should be checke also. In your case, it is advisable t keep the aerial well away from the ligh fitting and preferably to use a good out side aerial. If removal of the aeria from the set reduces the amount of inter ference from the light, it does not neces sarily infer that the interference i wholly arriving through the aerial. W would refer you to the article in th January, 1953, issue entitled How to Mak a Line Filter, in which the matter o interference currents in the chassis o a set is discussed and the circumstance mentioned in which a line filter will b of some assistance.

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